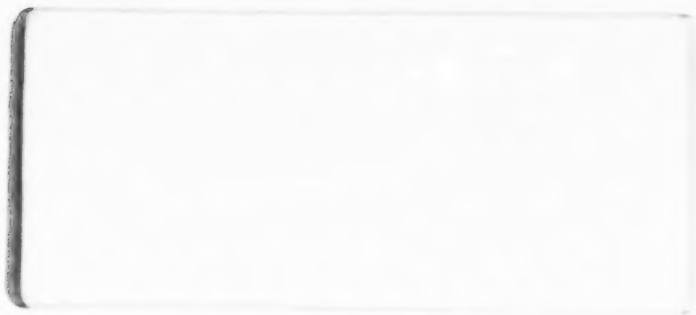


NANUK ENGINEERING

REPORT ON

**LITTLE BOW RIVER BASIN
PHASE II PLANNING ACTIVITIES
ANALYSIS OF WATER SUPPLY ALTERNATIVES**

TO
**ALBERTA ENVIRONMENT, PLANNING DIVISION
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The Little Bow River Basin, located in south-western Alberta, has experienced rapid growth in irrigated acreage and subsequently, increased demands on the water supply system. The water supply system consists primarily of water diverted from the Highwood River. Although natural runoff is present, the volume is highly variable and generally occurs outside the irrigation season. This study examined a wide range of alternatives for improving the water supply system and increasing the potential for irrigation development. The alternatives included;

1. increased diversion capacity
2. water storage at several onstream sites
3. Clear Lake Project
4. combinations of the above

The alternatives were evaluated with several values of minimum flow in the Highwood River. Providing this minimum flow was maintained, the analysis considered that 60% of the flow in the Highwood was available for diversion to the Little Bow Basin from April 15 to October 15. Current diversion capacity is 60 cfs at Squaw Coulee and 100 cfs in the Little Bow Canal.

Water requirements in the Little Bow Basin consisted of a municipal and riparian flow of 15 cfs and irrigation usage which was set at 1.5 acre-feet/acre with 1.0 acre-feet/acre available for irrigation withdrawal and 0.5 acre-feet/acre for spills, conveyance and losses. Natural runoff and reservoir evaporation were included in the analysis of onstream storage alternatives. The water requirements were tested against the water supply available through various diversion and storage schemes using historic, daily, natural flow in the Highwood River from 1909 to 1985. The reliability criteria applied to water supply was essentially a 90% probability that seasonal water requirement will be satisfied with maximum monthly deficits less than prescribed values.

The analysis of increased diversion canal capacities, without additional storage indicated;

1. Within the current diversion guidelines of 60% of the Highwood flow providing a minimum flow of 70 cfs is maintained, Little Bow Canal capacities above 300 cfs are relatively ineffective in increasing water supply.
2. If the Squaw Coulee diversion capacity is doubled to 120 cfs, the Little Bow Canal demonstrates a marked reduction in effectiveness above 200 cfs.
3. Doubling the minimum flows on the Highwood from 70 to 150 cfs reduces firm supply by approximately 10,000 ac-ft.
4. Selection of diversion capacity is relatively independent of minimum Highwood flows. The reduction of the water available for diversion by increasing minimum flows on the Highwood is similar for the various diversion capacities analyzed.

The development of any storage in the Little Bow Basin will have significant effect on the irrigation acreage that can be supported. Maximum acreage without storage is 19,300 while minimal storage development will provide water for 30,500 acres. At the existing diversion capacities and a minimum flow in the Highwood of 70 cfs, the reservoirs with lesser storage capacity support almost as much irrigation acreage as the larger reservoirs.

A large (70,000 ac-ft.) storage reservoir below the confluence of Mosquito Creek will not be effective without an increase in diversion capacity from the Highwood. Conversely, a substantial increase in diversion capacity (100 to 300 cfs in the Little Bow Canal) will not substantially increase irrigation acreage if a small reservoir site such as Little Bow #1 is constructed.

Increasing minimum flow requirements above 70 cfs in the Highwood River will significantly reduce potential irrigation development. Doubling the minimum flow will reduce irrigation potential by 20 to 30% depending on the configuration of the proposed supply system.

The Clear Lake Stabilization project can divert 10,000 ac-ft. from Mosquito Creek with a one year in 5 chance of impairing minimum flows in Mosquito Creek or reducing water supply to current users on Mosquito Creek. When combined with on-stream storage the project permits only a small increase in total irrigation development. In this situation, the benefit of diverting flows before and after the peak irrigation demand to Clear Lake do not exist and irrigation development at Clear Lake competes directly with development elsewhere.

2.0 BASES OF SIMULATIONS

2.1 SIMULATION MODEL OF THE BASIN

The physical configuration of the Basin was modelled as illustrated in Figure 2.1. The lower Little Bow has been designated Reach 1 in previous reports while the upper Little Bow River and Mosquito Creek were designated reaches 2 and 3 respectively. The current capacities of the Squaw Coulee diversion and Little Bow Canal are 60 cfs and 100 cfs respectively.

2.2 WATER SUPPLY

There are two sources of water for the Little Bow Basin; natural runoff and diversion from the Highwood River. The water available from the latter was based on estimates of daily natural flows of the Highwood River above the Squaw Coulee diversion. The daily flows were derived from gauge records on the Highwood River by Hydrocon Engineering (1984) for the years 1909 to 1984. The daily flows at the same location for 1983 and 1984 were calculated during this study. The complete hydrologic data file is contained on the enclosed diskette in IBM-PC MS/DOS format.

The annual natural runoff within the Mosquito Creek Basin was computed for April to October inclusive based on a regression analysis of flows of Willow Creek at Nolan and Mosquito Creek at Nanton. Winter runoff in the Little Bow Basin is small and has not been used in this study. The seasonal flows of the Little Bow at Carmangay were used to compute the runoff of the upper Little Bow and, occasionally to adjust the Mosquito Creek runoff. The natural runoff values are listed in Table 2.2. These unit runoff values were used in conjunction with the evaluation of reservoir sites. The seasonal runoff was computed using the drainage area upstream of the site and the calculated volume was added to storage in the reservoir in April of each year.

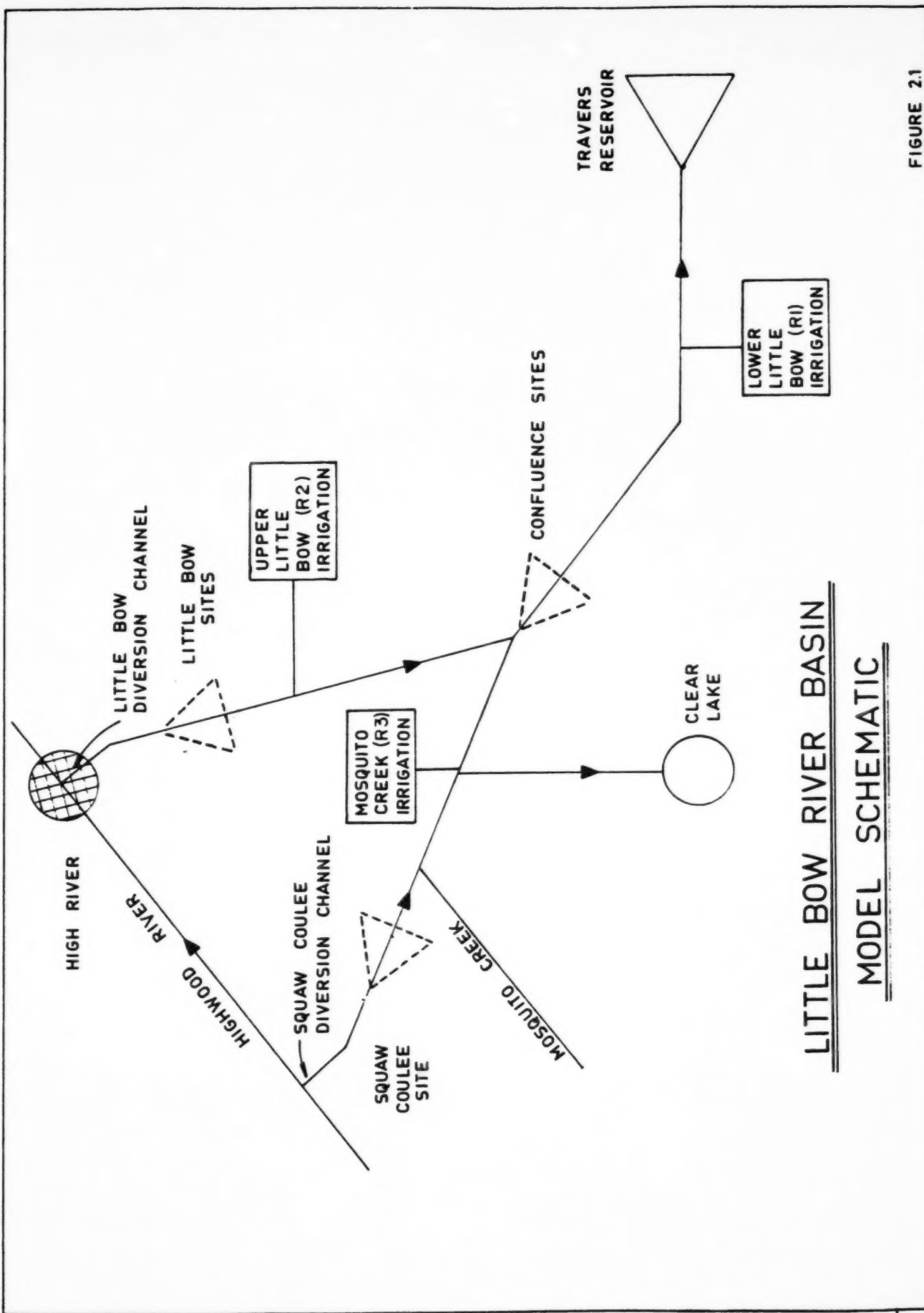


FIGURE 2.1

TABLE 2.2
NATURAL RUNOFF
LITTLE BOW RIVER BASIN
(ac-ft/sq.mi.)

YEAR	MOSQUITO CREEK	LITTLE BOW RIVER
1916	224	0
1917	263	0
1918	24	2
1919	8	12
1920	132	85
1921	14	15
1922	39	0
1923	144	2
1924	39	3
1925	51	12
1926	93	8
1927	225	31
1928	110	85
1929	114	8
1930	51	9
1931	0	12
1932	76	4
1933	55	13
1934	29	16
1935	21	9
1936	5	31
1937	7	7
1938	81	5
1939	25	12
1940	33	10
1941	16	12
1942	263	0
1943	57	21
1944	0	10
AVERAGE	76	15
RECENT ESTIMATES		
1983	10	9
1984	2	10

The natural flows in the years 1916 to 1944 were used in the simulation since this represents a critical sequence of flows in the historical period 1909 to 1984 and estimation of natural flows beyond 1944 is not accurate with the increase of irrigation withdrawals. The simulation period includes 5 of the driest 8 years with respect to water available for diversion from the Highwood.

2.3 WATER REQUIREMENTS

The primary water requirement in the basin was irrigation usage. Future water needs were based on a recent program of flow measurement and assessment of irrigation usage. The results of this program are presented in Table 2.3. The irrigation delivery requirement is the flow required in the channel to ensure a pumped withdrawal can physically be made. Since the gauged deliveries exceeded maximum withdrawal during each month, the annual delivery requirement used in the computer simulation program was set at 1.5 acre-feet per acre. Actual withdrawal was calculated to be approximately 1.0 acre-foot per acre and the flowby for delivery was therefore 0.5 acre-foot per acre. Upstream of a proposed reservoir, the flowby can be reused by the irrigation areas downstream of the reservoir. The water requirements were therefore set at;

1. 1.0 acre-feet/acre upstream of any reservoir (0.5 acre-feet/-acre flows to reservoir).
2. 1.5 acre-feet/acre between the most downstream reservoir and Travers

The monthly distribution of this seasonal water requirement was simulated using the values in Table 2.3.

In addition to the irrigation requirements a minimum instream flow of 5 cfs for municipal and other purposes was set in each of the upper Little Bow and Mosquito Creek. The minimum instream flow in the lower Little Bow was 15 cfs but the flows in the upper reaches contributed to this minimum such that the incremental flow requirement was 5 cfs.

TABLE 2.3

IRRIGATION DELIVERIES
LITTLE BOW RIVER BASIN

(derived from 1984/1985 overflight data)

	LOWER LITTLE BOW		UPPER LITTLE BOW		MOSQUITO CREEK	
	cfs	%	cfs	%	cfs	%
May	20	9	10	12.5	5	10
June	65	28	20	25	10	20
July	90	39	30	37.5	20	40
August	45	19.5	15	19	10	20
September	10	4.5	5	6	5	10
TOTAL (ac-ft)	14000	100%	4900	100%	3000	100%
1984 Acreage	8100		2900		1667	
1985 Acreage	8368		2929		1973	
Average Unit Delivery Rate	1.70 ft.		1.67 ft.		1.67 ft.	

2.4 STORAGE ALTERNATIVES

The reservoir sites considered in this study were:

1. Little Bow 1 (LB #1)
2. Little Bow 3 (LB #3)
3. Squaw Coulee 2 (SQ #2)
4. Confluence Sites 7B-1 (Conf #7B1)

The site parameters used in the computer simulation of the Basin are;

SITE	DRAINAGE AREA (sq.mi.)	LIVE STORAGE (ac-ft.)
LB #1	30	15,500
LB #3	104	50,000
SQ #2	20	14,400
Conf #7B1	21*	30, 50 & 70,000
Conf #7A	21*	30, 50 & 70,000

* on Little Bow plus full drainage area on
Mosquito Creek (325 sq.mi.)

The area/storage-elevation tables for these reservoir sites are reproduced in Appendix A.

2.5 RELIABILITY CRITERIA

When the simulation program was used to determine the maximum irrigation acreage that can be supported by a particular supply alternative, reliability criteria were applied to the simulation results. These criteria were;

1. The maximum irrigation development upstream of a reservoir shall be based on providing 90% of the annual water requirement, 90% of the time. August water supply may be less than 50% of the water requirement, 10% of the time.

2. The maximum irrigation development downstream of a reservoir shall be based on providing 90% of the annual water requirements, 90% of the time. The maximum anticipated annual deficit shall not exceed 25%. Shortages in July and August shall not exceed 10% and 20% respectively of the monthly requirement.

In the application of these criteria, consideration was given to the presence of approximate natural flow data in the years 1931, 1932, 1933, 1936 and 1937.

3.0 SIZING OF DIVERSION CANALS

3.1 GENERAL

The maximum volumes of water that can be diverted from the Highwood River through the Squaw Coulee diversion and the Little Bow Canal were computed for various diversion capacities in each facility and varying minimum residual flows in the Highwood River downstream of the Town of High River. The purpose of these computations was the assessment of the sensitivity of diversion volumes to increased diversion capacities and modification of the operating guidelines.

The basis of the diversion calculations were;

1. Daily flows in the Highwood upstream of the Squaw Coulee diversion for the years 1909 to 1984.
2. Maximum allowable diversion on a daily basis through both structures was 60% of the flow of the Highwood River.
3. Diversion rates could not exceed the design capacity of the respective diversion canal.
4. Diversion took place from April 15 to October 15.
5. Minimum flow downstream of High River of 70 cfs.

3.2 VARIATION OF DIVERSION CAPACITIES

The maximum monthly and annual volumes that could have been diverted from the Highwood River were computed for the following scenarios;

1. Variation of the diversion capacity of the Little Bow Canal from 100 cfs to 500 cfs in increments of 100 cfs.
2. Two capacities of the Squaw Coulee diversion; 60 and 120 cfs

The results of the computation are illustrated in two flow duration curves, Figures 3.2.1 and 3.2.2, and 10 tables of monthly and annual diversion which are provided in Appendix B. The flow duration curves show the effect of increasing the capacity of the Little Bow Canal for each of the two capacities of the Squaw Coulee diversion.

The conclusions that can be drawn from the results are;

1. With the Squaw Coulee diversion capacity at 60 cfs, the 90% exceedance volume improves substantially by increasing the diversion capacity of the Little Bow Canal from 100 to 200 cfs. Successive, incremental increases in diversion capacity result in considerably less increases in diversion volume. Based on the 60% - 70 cfs guideline, the most effective canal size is between 200 and 300 cfs. Firm diversion volumes (90% exceedance values) are 58,000 acre-feet at 200 cfs, and 67,000 acre-feet at 300 cfs.
2. For the Squaw Coulee diversion capacity of 120 cfs, the firm diversion volume at 200 cfs in the Little Bow Canal is 64,000 acre-feet. Increasing the diversion capacity to 300 cfs results in a 6,000 acre-foot increase in firm diversion. A 200 cfs capacity appears to be the more effective choice in this situation.

3.3 VARIATION OF MINIMUM HIGHWOOD FLOWS

The maximum annual volumes that can be diverted to the Little Bow Basin from the Highwood River were computed with minimum flows downstream of High River varying from 70 to 250 cfs. The scenarios examined were combinations of the following;

1. Squaw Coulee diversion capacity fixed at 60 cfs
2. 100, 200 & 300 cfs capacities on the Little Bow Canal
3. Minimum flow in the Highwood of 70, 100, 150, 175, 200 & 250 cfs

Duration Curves: Total Diversion

LB=100 to 500, SQ=60, D/S=70, MAX=60%

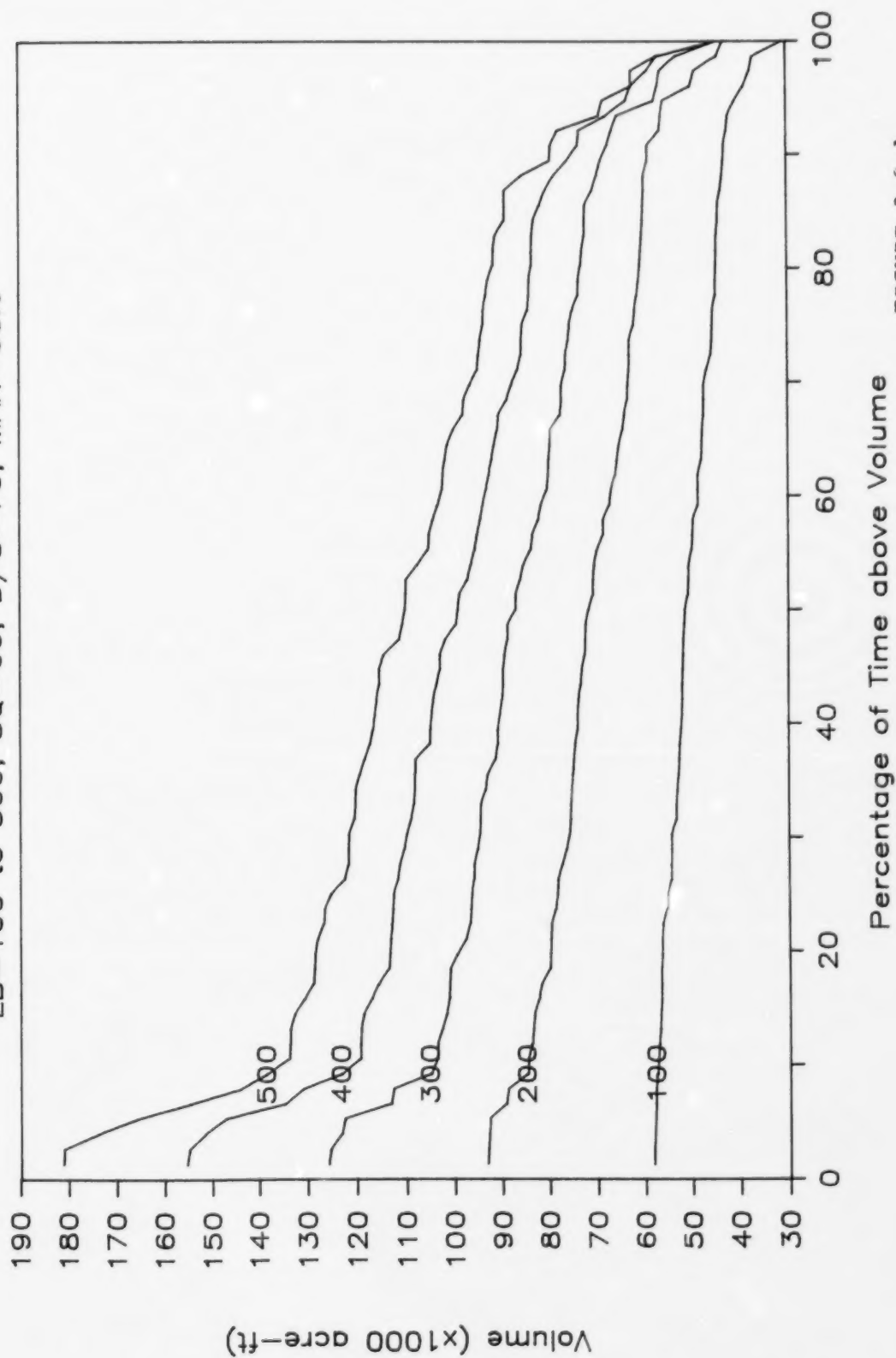


FIGURE 3.2.1

Duration Curves: Total Diversion

LB=100 to 500, SQ=120, D/S=70, MAX=60%

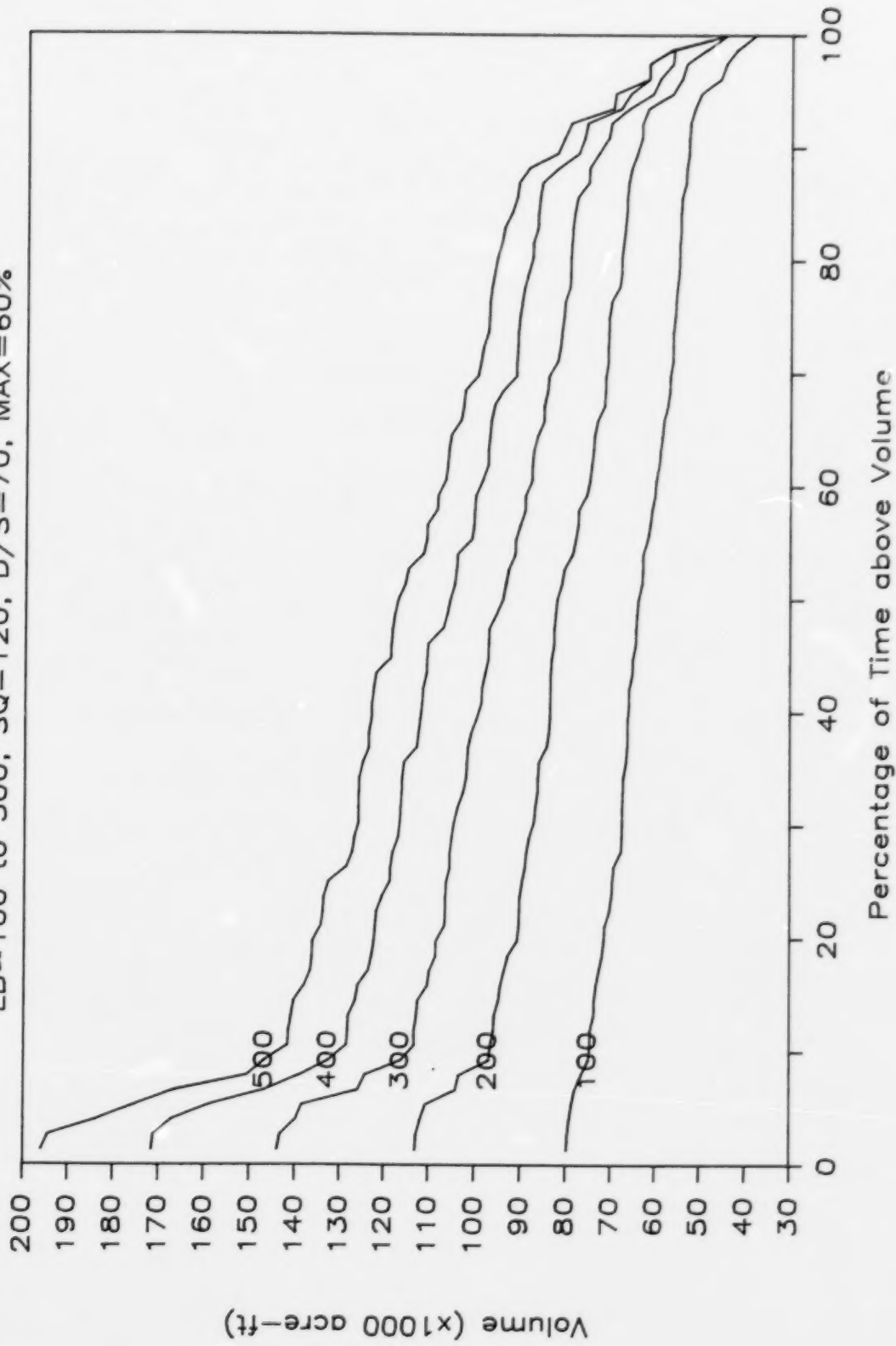


FIGURE 3.2.2

The results of these computations are best portrayed in Figure 3.3.1 which shows the reduction in firm supply by diversion with increasing downstream minimum flow requirements. The firm supply is that volume which should be available 90% of the time by diversion from the Highwood. This figure is supported by three flow duration curves (Figures 3.3.2 to 3.3.4) which show the total annual diversion for each of the canal capacities and varying minimum flow in the Highwood.

The conclusions which can be drawn from these analyses are;

1. The decrease in firm supply with increasing minimum flows is almost equal (in an absolute sense) for the three canal capacities at the lower minimum flow requirements (70 - 150 cfs).
2. The 300 cfs canal has a greater loss in effectiveness than the 100 cfs capacity at the higher minimum flows (150 cfs) - a loss in firm supply of 14,000 ac-ft. versus 8,000 ac-ft.
3. The 200 cfs canal provides a relatively greater increase in firm supply (135%) over the 100 cfs capacity than the 300 cfs canal does over the 200 cfs capacity (115%).

HIGHWOOD DIVERSION

SQ=60 LB=100,200,300 cfs MAX=60%

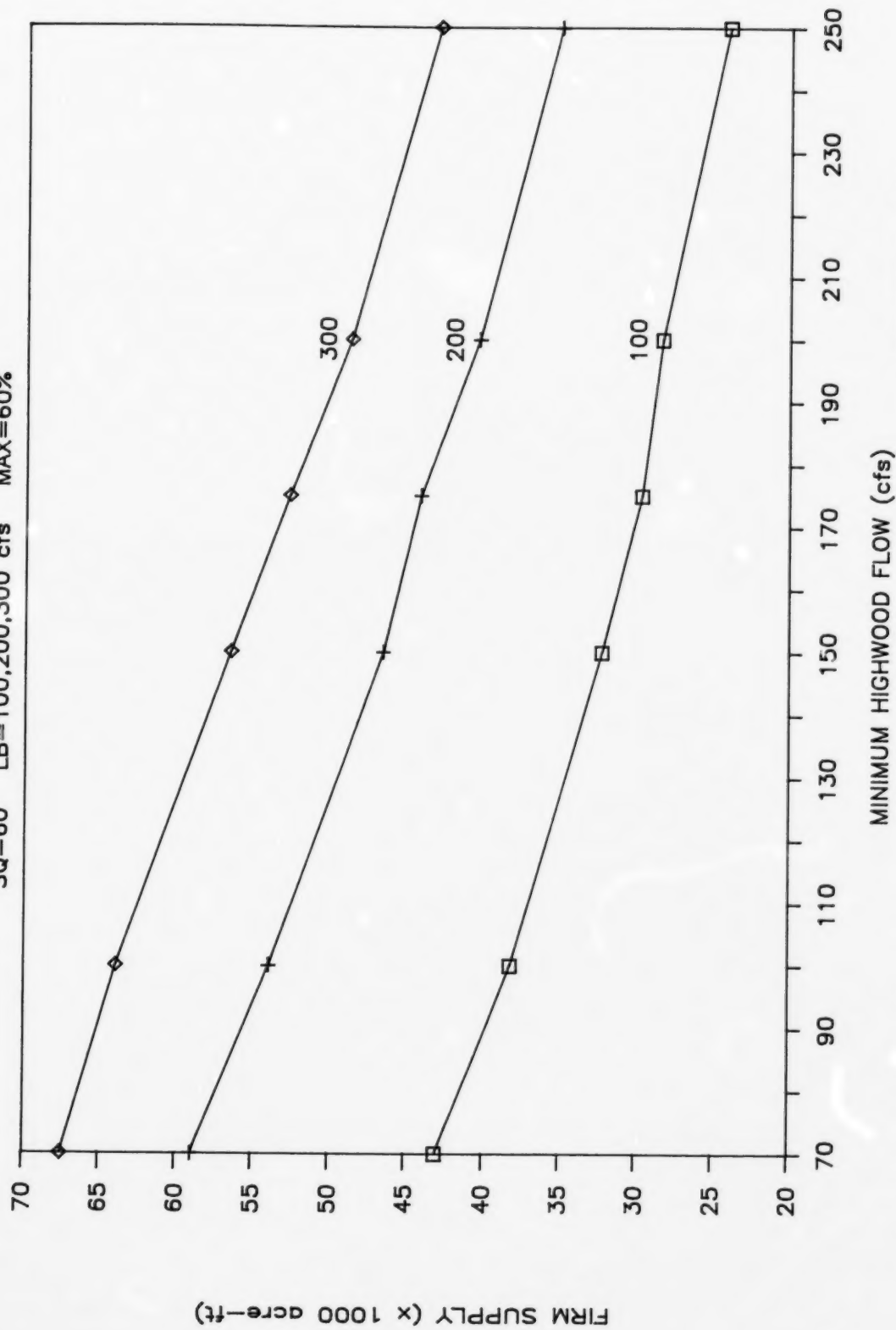


FIGURE 3.3.1

Duration Curves: Total Diversion

LB=100 SQ=60 D/S = 70-250 cfs

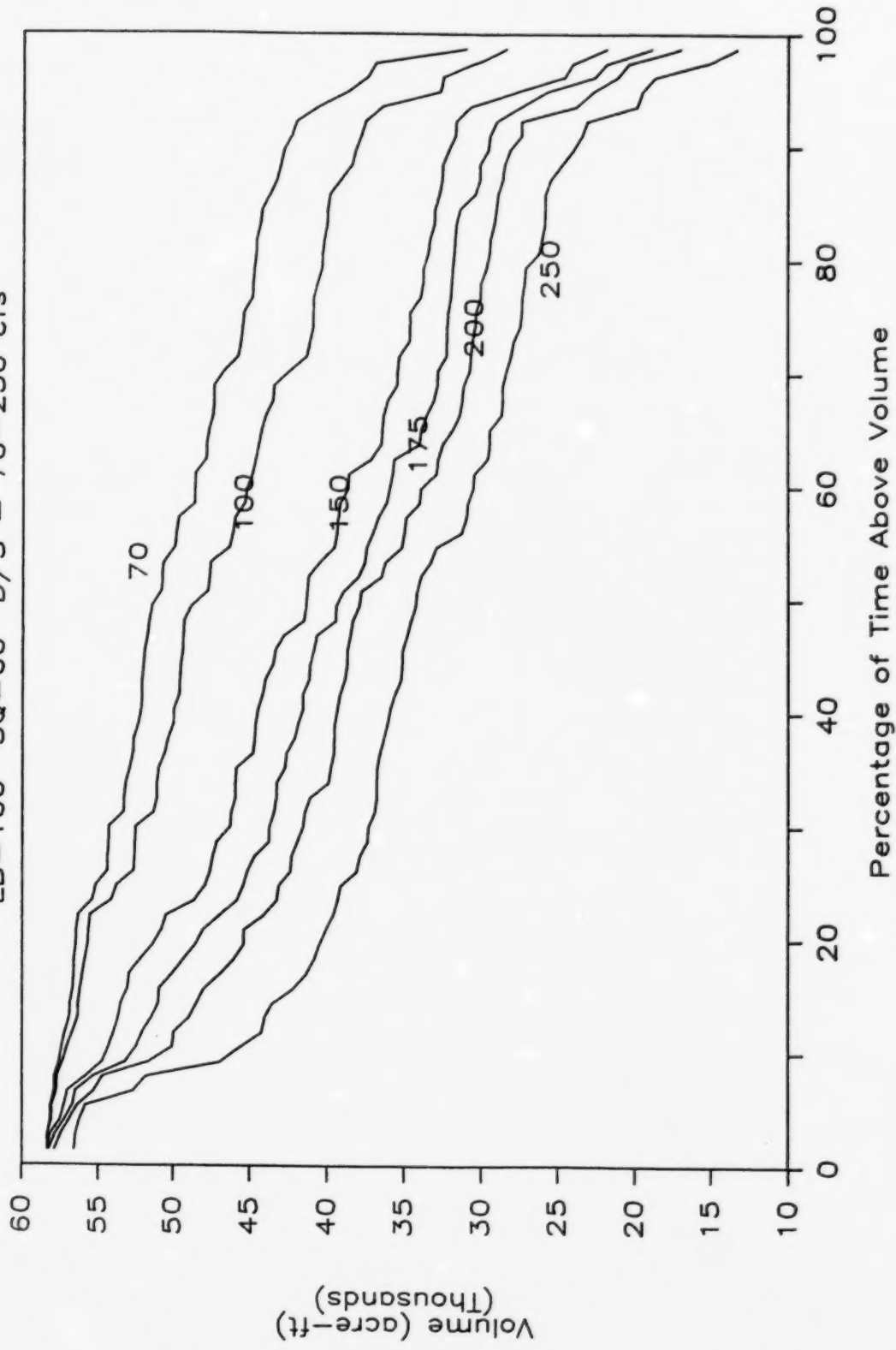


FIGURE 3.3.2

Duration Curves: Total Diversion

LB=300 SQ=60 D/S = 70-250 cfs

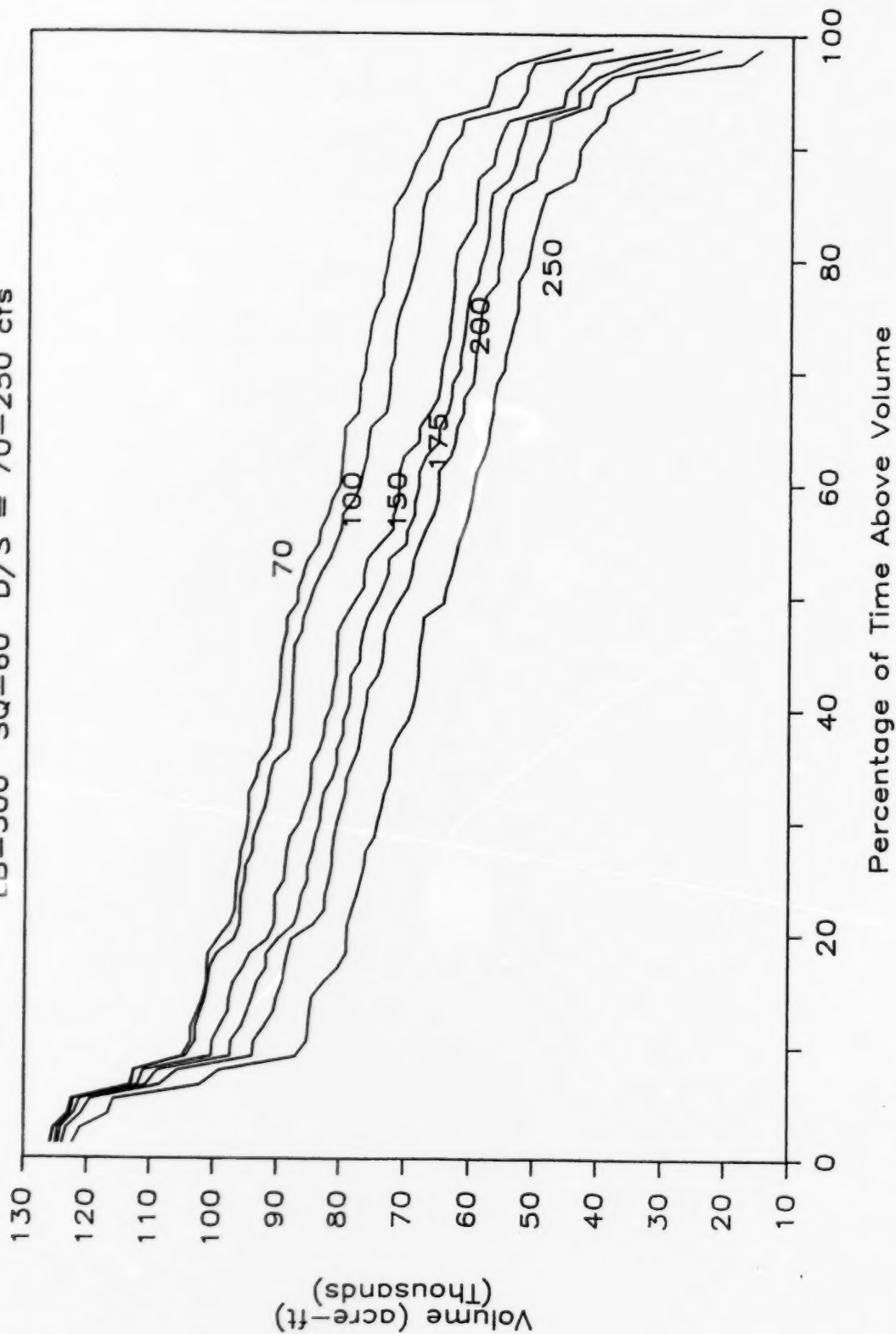


FIGURE 3.3.3

Duration Curves: Total Diversion

LB=200 SQ=60 D/S = 70-250 cfs

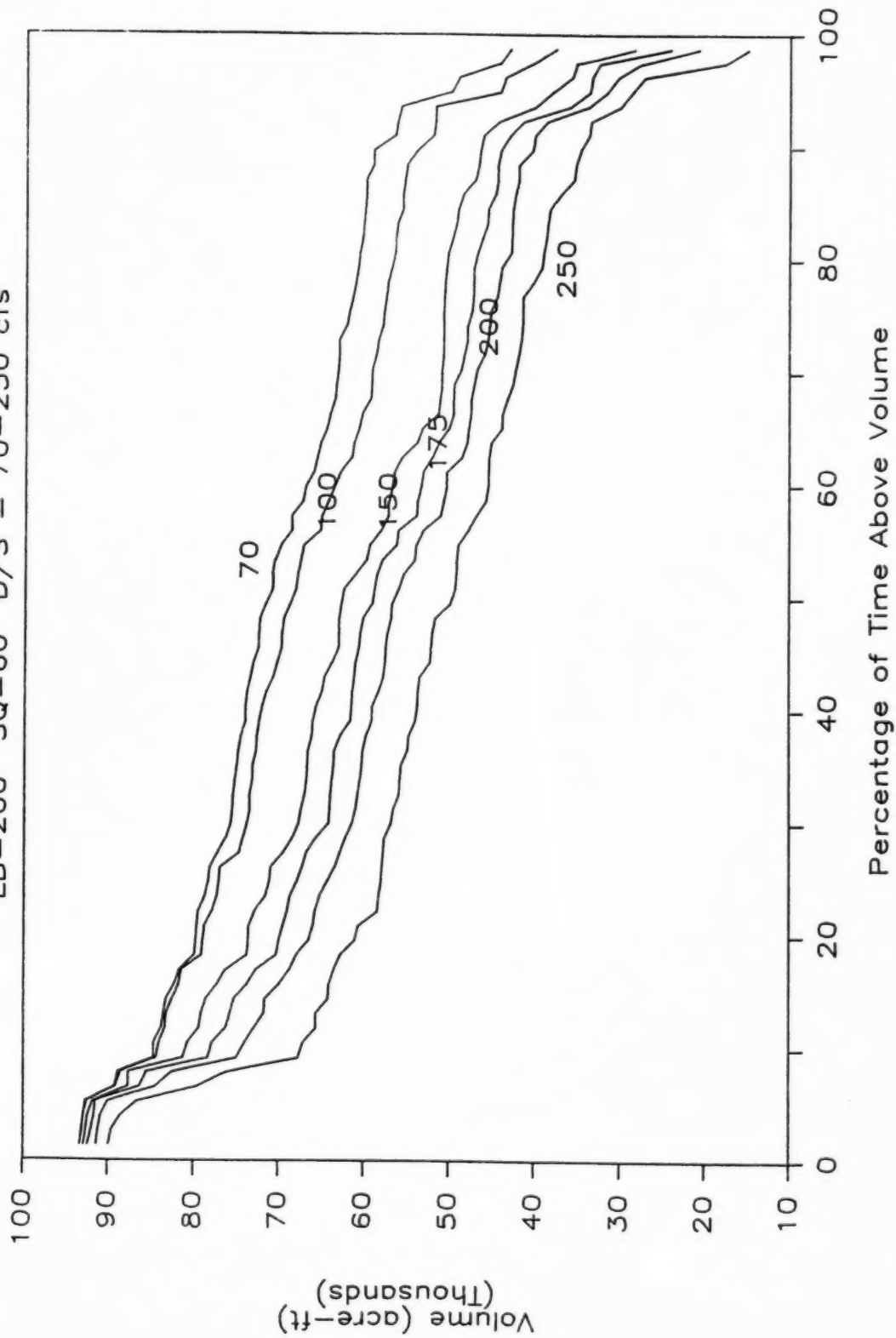


FIGURE 3.3.4

4.0 EVALUATION OF RESERVOIR SITES

4.1 GENERAL

The purpose of the evaluation of reservoir sites was the determination of the maximum irrigation development that could be supported on the Little Bow Basin with various diversion canal capacities and minimum Highwood flow requirements. Five potential sites, Little Bow #1, Little Bow #3, Squaw Coulee #2 and confluence sites 7B-1 and 7A were examined as well as the present level of development (no appreciable storage).

4.2 PRESENT DEVELOPMENT

The effects on irrigation potential of present development in the Little Bow Basin was examined for a minimum downstream flow requirement in the Highwood of 70 cfs and three capacities; 100, 200 and 300 cfs, in the Little Bow Canal. The Squaw Coulee diversion was not changed from its present capacity of 60 cfs. The results of these analyses are presented in Table 4.2.1. The irrigation acreages were determined in accordance with the reliability criteria discussed in Section 2 'Bases of Simulations'. The values shown are total, not incremental, acreage. Although the table shows only 4800 acres as the irrigation acreage above the confluence, this is the existing acreage and may be increased. The acreage below the confluence has been maximized in these simulations. Acreage may be transferred from below the confluence to above, and, in fact, total acreage may increase since that portion of the delivery requirement not used by upstream irrigators may be used below the confluence.

The potential for irrigation development presented in Table 4.2.1 appears to contradict the recent water shortages experienced by the present irrigation acreage. Previous studies indicated that the current acreage was compatible with the guideline which permitted 10% of the Highwood flows to be

TABLE 4.2.1
PRESENT DEVELOPMENT
SUMMARY OF RESULTS

LITTLE BOW CANAL (cfs)	MINIMUM HIGHWOOD FLOW (cfs)	SQUAW COULEE DIVERSION (cfs)	IRRIGATION DEVELOPMENT			FIRM FLOW TO TRAVERS (ac-ft) (see note)
			ABOVE CONFL. (acres)	BELOW CONFL. (acres)	TOTAL (acres)	
100	70	60	4,800	14,500	19,300	25,300
200	70	60	4,800	19,500	24,300	35,800
300	70	60	4,800	20,500	25,300	41,000
PRESENT ACREAGE			4,800	8,300	13,100	---

- NOTES: 1. Does not include 15 cfs (5500 ac-ft) municipal and riparian flow over diversion season (Apr 15 to Oct 15).
2. Values based on diverting maximum volumes under the 60%/70 cfs guideline.

diverted through Squaw Coulee and 30% through the Little Bow Canal. Also 1984 and possibly 1985 were exceptionally dry years. The volume of water that could have been diverted from the Highwood in 1984 was approximately a 1 in 20 year occurrence.

The maximum acreage that can be supported on Mosquito Creek by the Squaw Coulee diversion at 60 cfs is 6700 acres including the existing acreage. The maximum acreage on the Upper Little Bow is dependent on the capacity of the Little Bow Canal and the assumption that the existing acreages on Mosquito Creek (1900 acres) and the lower Little Bow (8300 acres) will not increase. Table 4.2.2 presents the realizable maxima for the reaches above the confluence.

The present development was also examined in the light of increased minimum flow requirements in the Highwood. Minimum flow values of 175 and 250 cfs were simulated with Little Bow Canal capacities of 100, 200 and 300 cfs. The results showed that the existing irrigation development of 13,100 acres could not be sustained within the reliability criteria in any of the six cases examined. Principally, annual shortages on all reaches in excess of 10% of the water requirement were experienced more than 90% of the time.

4.3 UPPER LITTLE BOW RESERVOIR SITES

The upper Little Bow sites, #1 and #3, were analyzed for the maximum irrigation development they could support with various capacities of the Little Bow Canal and minimum flow in the Highwood River. The diversion capacity at Squaw Coulee was maintained at 60 cfs. Table 4.3 presents the results of these analyses. The irrigation development above the confluence was maximized for the 100 cfs capacity in the Little Bow Canal within each minimum flow category and was not adjusted upward for increased diversion capacity. This was done to keep the number of computer simulations to a reasonable number.

TABLE 4.2.2

PRESENT DEVELOPMENT
MAXIMUM IRRIGATION ACREAGE PER REACH

LITTLE BOW CANAL	MINIMUM HIGHWOOD FLOW (cfs)	SQUAW COULEE DIVERSION (cfs)	MAXIMUM ACREAGE			
			UPPER LITTLE BOW (acres)	MOSQUITO CREEK (acres)	ABOVE CONFLUENCE (acres)	BELOW CONFLUENCE (acres)
100	70	60	9,100	6,700	11,000	14,500
200	70	60	14,100	6,700	16,000	19,500
300	70	60	15,100	6,700	17,000	20,500

NOTE: MAXIMUM ACREAGES ARE NOT ADDITIVE.

TABLE 4.3

UPPER LITTLE BOW RESERVOIR SITES
SUMMARY OF RESULTS

STORAGE ALTERNATIVE	LITTLE BOW CANAL (cfs)	MINIMUM HIGHWOOD FLOW (cfs)	SQUAW COULEE DIVERSION (cfs)	RESERVOIR CAPACITY (ac-ft)	IRRIGATION DEVELOPMENT		FIRM FLOW TO TRAVERS (ac-ft) (see note)
					ABOVE CONFL. (acres)	BELOW CONFL. (acres)	
LB #1	100	70	60	17,250	14,000	16,500	30,500
	200	70	60		14,000	24,000	38,000
	300	70	60		14,000	25,500	39,500
LB #1	100	175	60	17,250	10,000	10,500	20,500
	200	175	60		10,000	15,500	25,500
	300	175	60		10,000	15,700	25,700
LB #1	100	250	60	17,250	4,800	10,300	15,100
	200	250	60		4,800	11,800	16,500
	300	250	60		4,800	11,800	16,600
LB #3	100	70	60	50,000	14,000	17,500	31,500
	200	70	60		14,000	29,500	43,500
	300	70	60		14,000	37,000	51,000

NOTE: does not include 15 cfs (5500 ac-ft) municipal and
riparian flow

4.4 MOSQUITO CREEK REACH: RESERVOIR SITE

Squaw Coulee site #2 was evaluated for two diversion capacities at Squaw Coulee; 60 and 120 cfs and three Little Bow Canal capacities; 100, 200 and 300 cfs. The results are displayed in Table 4.4.

4.5 CONFLUENCE SITES

Several potential sites for reservoirs were identified downstream of the confluence of Mosquito Creek and the Little Bow River. Since the confluence site could be built at various storage capacities up to 70,000 ac-ft., the effectiveness of increased storage was examined with a range of capacities in the Little Bow Canal and three values of minimum flows in the Highwood. The results of this examination are presented in Table 4.5.

4.6 COMBINATION OF RESERVOIR SITES

Two combinations of reservoir sites were simulated to compare with single site storage development. The two smaller reservoirs, Little Bow #1 and Squaw Coulee #2 were evaluated for a single value of minimum flow in the Highwood and Little Bow Canal capacities of 100, 200 and 300 cfs. The Squaw Coulee diversion was set at its existing value of 60 cfs. The other combination was a 70,000 ac-ft. confluence site combined with the two smaller sites on the upper Little Bow and Squaw Coulee. This combination was evaluated at a Little Bow Canal capacity for 300 cfs since earlier work had shown that a 70,000 ac-ft. confluence site is more effective with a 300 cfs diversion capability. The minimum flow in the Highwood was set at 70 cfs and the capacity of the Squaw Coulee diversion was maintained at 60 cfs.

The results of these analyses are listed in Table 4.6

TABLE 4.4
MOSQUITO CREEK REACH: RESERVOIR SITES
SUMMARY OF RESULTS

LITTLE BOW CANAL	MINIMUM HIGHWOOD FLOW	SQUAW COULEE DIVERSION	RESERVOIR CAPACITY	IRRIGATION DEVELOPMENT		FIRM FLOW TO TRAVERS
(cfs)	(cfs)	(cfs)	(ac-ft)	ABOVE CONFL. (acres)	BELOW CONFL. (acres)	(ac-ft) (see note)
100	70	60	14,400	12,800	14,000	26,800 16,500
200	70	60	14,400	12,800	18,500	31,300 28,000
300	70	60	14,400	12,800	19,000	31,800 35,300
100	70	120	14,400	12,800	20,000	32,800 19,400

NOTE: does not include 15 cfs (5500 ac-ft) municipal and
riparian flow

TABLE 4.5

CONFLUENCE RESERVOIR
SUMMARY OF RESULTS

MINIMUM D/S FLOW (cfs)	LITTLE BOW CANAL CAP. (cfs)	RESERVOIR CAPACITY (ac-ft.)	IRRIGATION DEVELOPMENT		TOTAL DEV.	FIRM FLOW TO TRAVERS (ac-ft.) SEE NOTE
			ABOVE CONFL. (acres)	BELOW CONFL. (acres)	(acres)	
70	100	30000	15500	22000	37500	11900
70	200	30000	15500	28500	44000	16100
70	300	30000	15500	31500	47000	19800
70	100	50000	15500	23500	39000	12400
70	200	50000	15500	32000	47500	17600
70	300	50000	15500	38000	53500	20900
70	100	70000	15500	24000	39500	12300
70	200	70000	15500	34500	50000	17900
70	300	70000	15500	41500	57000	21900
70	300*	70000	15500	76000	91500	38000
70	500	70000	15500	57500	73000	30000
175	100	30000	4800	21000	25800	11200
175	300	30000	4800	28500	33300	21500
175	100	50000	4800	22000	26800	11700
175	200	50000	4800	32000	36800	16900
175	300	50000	4800	37000	41800	19400
175	100	70000	4800	23000	27800	11800
175	200	70000	4800	33000	37800	17200
175	300	70000	4800	40500	45300	21100
175	500	70000	4800	47500	52300	25000
250	100	30000	4800	19000	23800	9700
250	300	30000	4800	22000	26800	15000
250	100	50000	4800	20000	24800	10700
250	200	50000	4800	27000	31800	14300
250	300	50000	4800	31500	36300	17400
250	100	70000	4800	20000	24800	10300
250	200	70000	4800	29000	33800	15200
250	300	70000	4800	35500	40300	18400
250	500	70000	4800	42500	47300	22900

NOTE: does not include 15 cfs (5,500 acre-feet) municipal and riparian flow.

* assumes regulated flows in Highwood River and 60 cfs diversion at Squaw Coulee

TABLE 4.6

COMBINATIONS OF RESERVOIR SITES
SUMMARY OF RESULTS

STORAGE ALTERNATIVE	LITTLE BOW CANAL (cfs)	MINIMUM HIGHWOOD FLOW (cfs)	SQUAW COULEE DIVERSION (cfs)	RESERVOIR CAPACITY (ac-ft)	IRRIGATION DEVELOPMENT		FIRM FLOW TO TRAVERS (ac-ft) (see note)
					ABOVE CONFL. (acres)	BELOW CONFL. (acres)	
LB #1 AND SQ #2	100	70	60	17,250	14,000	19,000	13,300
	200	70	60	14,400	14,000	28,000	20,100
	300	70	60		14,000	30,500	25,600
CONF. #7B1, LB #1 AND SQ #2	300	70	60	70,000	14,000	44,300	22,400
				17,250			
				14,400			

NOTE: does not include 15 cfs (5500 ac-ft) municipal and
riparian flow

4.7 OBSERVATIONS ON RESULTS

The development of any storage in the Little Bow Basin will have significant effect on the irrigation acreage that can be supported at current diversion capacities and minimum flows. Maximum acreage without storage is 19,300 acres while a minimal storage development such as Little Bow #1 will provide water for 30,500 acres. It should also be emphasized that the reliability of supply will be improved on the latter acreage since the criteria for irrigation downstream of a reservoir was more stringent than that applied to the existing mode of water supply.

At the existing capacities of the diversion and a minimum flow in the Highwood of 70 cfs, the smaller reservoirs support almost as much irrigation acreage as the larger reservoirs as shown below;

SITE	IRRIGATION DEVELOPMENT (acres)
LITTLE BOW #1	30,500
SQUAW COULEE #2	26,800
LITTLE BOW #3 @ 50,000 ac-ft.	31,500
CONFLUENCE SITE @ 30,000 ac-ft.	37,000

A confluence site does, however, take advantage of the substantially higher natural runoff from both Mosquito Creek and the upper Little Bow.

Increasing the confluence site storage beyond 30,000 ac-ft. at existing diversion capacities and 70 cfs minimum flow does not increase the irrigation acreage appreciably as shown below;

CONFLUENCE SITE CAPACITY (ac-ft).	IRRIGATION DEVELOPMENT (acres)
30,000	37,000
50,000	38,500
70,000	39,000

Increasing diversion capacity has a lesser effect on the Irrigation acreage that can be supported on small sites with a minimum flow of 70 cfs when compared to larger sites, viz;

LITTLE BOW CANAL CAPACITY (cfs)	IRRIGATION DEVELOPMENT (acres)		
	LB #1	LB #3 @ 50,000 ac-ft.	Confluence Site @ 70,000 ac-ft.
100	30,500	31,500	39,000
200	38,000	43,500	49,500
300	39,000	51,000	56,000

Increasing minimum flow requirements in the Highwood River will significantly reduce the potential Irrigation development. At 175 cfs minimum flow, a 70,000 ac-ft. reservoir supports less acreage than 30,000 ac-ft. of storage at a minimum Highwood flow of 70 cfs and at 250 cfs minimum flow, the Little Bow Canal capacity would have to be increased to 500 cfs to support the same acreage. These comparisons are shown below;

MINIMUM D/S FLOW (cfs)	LITTLE BOW CAPACITY (cfs)	RESERVOIR CAPACITY (ac-ft)	TOTAL IRRIGATION DEVELOPMENT (acres)
70	300	30,000	47,000
175	300	70,000	45,300
250	500	70,000	47,300

5.0 EVALUATION OF CLEAR LAKE PROJECT

5.1 GENERAL

The purposes of this evaluation were confirmation that the present water supply system can support the Clear Lake project and assessment of the effect of the project on future irrigation development elsewhere in the Basin within an improved water supply system.

The Clear Lake project was defined, within the simulation model, as an 8,000 acre irrigation development with a diversion requirement of 9,500 ac-ft. distributed as follows;

April	900 ac-ft.
May	2700
June	2700
July	900
August	0
September	1800
October	500

TOTAL	9500 ac-ft.

This pattern of diversion was allocated to the Clear Lake project so as it minimize the effect on water supply to downstream water user's, particularly in the peak demand months of July and August. The diversion was to take place upstream of most of the irrigation development on Mosquito Creek. There was no return flow from the project.

5.2 CURRENT SUPPLY FOR CLEAR LAKE

The ability to supply water for the Clear Lake project was determined based on satisfying the current water requirements on Mosquito Creek within the current diversion capabilities and operating regime. The water requirements were;

1. 2000 acres of Irrigation on Mosquito Creek
2. a minimum residual flow of 10 cfs after diversion to Clear Lake and withdrawals by on-stream irrigators along Mosquito Creek

The current regime for diversion was considered to be;

1. Squaw Coulee diversion capacity of 60 cfs
2. a maximum of 60% of the flow in Highwood can be diverted to the Little Bow Basin
3. the flow in the Highwood downstream of High River shall not be less than 70 cfs

The water surplus to existing requirements on Mosquito Creek was computed on basis of the Squaw Coulee diversion operating at its maximum capacity but within the current guidelines. The flows available in the Highwood from 1909 to 1985 were used to provide a probabilistic assessment of water currently available for the Clear Lake project. The results of the computation are presented in Table 5.2 which lists the chronologic monthly and annual volumes and the ranked annual volumes with the corresponding year.

The results show that 80% of the time 10,000 ac-ft. is available for the project. Also, out of the past 5 years, only in 1984 would there be slightly less than 10,000 ac-ft. available for Clear Lake. It is also important to note, that the computation directs a total of 2460 ac-ft. from Mosquito Creek during June, July and August to meet the water requirements of an 8,000 acre project at Clear Lake.

5.3 FUTURE BASIN DEVELOPMENT INCLUDING CLEAR LAKE

The effect of the Clear Lake project on other future irrigation development in the Basin was assessed by simulating three water supply schemes with, and without, the Clear Lake project and maximizing the on-stream irrigation acreage. The three water supply schemes were;

TABLE 5.2
WATER AVAILABLE FOR CLEAR LAKE²
(ac-ft)

60%/70 CFS GUIDELINE
60 CFS SQUAW COULEE CAPACITY

YEAR	APRIL	MAY	JUNE	AUGUST	SEPT.	OCT.	TOTAL	YEAR	VOLUME
1909	1588	2769	1191	1270	2680	1489	10986	1936	5540
1910	1588	2769	1191	1270	2680	1489	10986	1931	7636
1911	1156	2769	1191	1270	2680	1489	10554	1960	8160
1912	1588	2769	1191	1270	2680	1489	10986	1963	8168
1913	1588	2769	1191	1270	2680	1489	10986	1922	8477
1914	1588	2769	1191	1270	2554	1478	10849	1944	8575
1915	1588	2769	1191	1270	2680	1489	10986	1961	9271
1916	1588	2769	1191	1270	2680	1489	10986	1937	9399
1917	1588	2769	1191	1270	2680	1489	10986	1984	9727
1918	1588	2769	1191	1270	2680	1489	10986	1934	9789
1919	1465	2769	1191	1270	2527	1375	10596	1945	9898
1920	1574	2769	1191	1270	2502	1138	10443	1971	9962
1921	1588	2769	1191	1270	2392	1363	10572	1967	9976
1922	1571	2769	1191	1260	1371	316	8477	1941	9986
1923	1527	2769	1191	1270	2680	1489	10925	1962	10070
1924	1588	2769	1191	1270	2680	1489	10986	1950	10116
1925	1588	2769	1191	1270	2680	1489	10986	1968	10152
1926	1588	2769	1191	1270	2680	1489	10986	1949	10211
1927	1588	2769	1191	1270	2680	1489	10986	1938	10292
1928	1588	2769	1191	1270	2680	1489	10986	1943	10375
1929	1588	2769	1191	1268	2668	1440	10923	1964	10380
1930	1588	2769	1191	1270	2680	1489	10986	1920	10443
1931	549	2769	1191	1270	1735	123	7636	1979	10445
1932	1588	2769	1191	1270	2680	1489	10986	1911	10554
1933	1588	2769	1191	1270	2680	1069	10566	1933	10566
1934	1588	2769	1191	1270	1777	1195	9789	1921	10572
1935	1588	2769	1191	1270	2668	1320	10805	1919	10596
1936	1580	2769	1191	0	0	0	5540	1940	10648
1937	0	2769	1191	1270	2680	1489	9399	1970	10655
1938	1588	2769	1191	1262	2220	1263	10292	1977	10712
1939	1395	2769	1191	1270	2675	1489	10788	1957	10743
1940	1588	2769	1191	1120	2492	1489	10648	1983	10763
1941	1110	2769	1191	748	2680	1489	9986	1966	10766
1942	1588	2769	1191	1270	2680	1489	10986	1981	10775
1943	1588	2769	1191	1270	2553	1005	10376	1939	10788
1944	706	2769	1191	1270	1969	671	8575	1935	10805
1945	552	2737	1191	1270	2680	1489	9898	1914	10849
1946	1588	2769	1191	1270	2680	1489	10986	1948	10867
1947	1588	2769	1191	1270	2680	1489	10986	1955	10908
1948	1469	2769	1191	1270	2680	1489	10867	1929	10923
1949	1588	2769	1191	1142	2201	1321	10211	1923	10925
1950	1588	2769	1191	1270	2292	1007	10116	1973	10931
1951	1588	2769	1191	1270	2680	1489	10986	1953	10962
1952	1588	2769	1191	1270	2680	1489	10986	1958	10974
1953	1564	2769	1191	1270	2680	1489	10962	1954	10978
1954	1588	2761	1191	1270	2680	1489	10978	1985	10984
1955	1510	2769	1191	1270	2680	1489	10908	1909	10986
1956	1588	2769	1191	1270	2680	1489	10986	1910	10986
1957	1588	2769	1191	1270	2631	1295	10743	1912	10986
1958	1588	2769	1191	1270	2680	1477	10974	1913	10986
1959	1588	2769	1191	1270	2680	1489	10986	1915	10986
1960	1588	2769	1191	1270	1277	66	8160	1916	10986
1961	30	2612	1191	1270	2680	1489	9271	1917	10986
1962	1588	2769	1191	1148	2506	869	10070	1918	10986
1963	1147	2769	1191	1260	1706	96	8168	1924	10986
1964	982	2769	1191	1270	2680	1489	10380	1925	10986
1965	1588	2769	1191	1270	2680	1489	10986	1926	10986
1966	1588	2769	1191	1270	2541	1408	10766	1927	10986
1967	1156	2769	1191	1270	2421	1170	9976	1928	10986
1968	754	2769	1191	1270	2680	1489	10152	1930	10986
1969	1588	2769	1191	1270	2680	1489	10986	1932	10986
1970	1588	2769	1191	1215	2535	1358	10655	1942	10986
1971	1588	2769	1191	1270	2116	1029	9962	1946	10986
1972	1588	2769	1191	1270	2680	1489	10986	1947	10986
1973	1588	2769	1191	1269	2680	1435	10931	1951	10986
1974	1588	2769	1191	1270	2680	1489	10986	1952	10986
1975	1588	2769	1191	1270	2680	1489	10986	1956	10986
1976	1588	2769	1191	1270	2680	1489	10986	1959	10986
1977	1330	2769	1191	1254	2680	1489	10712	1965	10986
1978	1588	2769	1191	1270	2680	1489	10986	1969	10986
1979	1588	2769	1191	1270	2612	1016	10445	1972	10986
1980	1588	2769	1191	1270	2680	1489	10986	1974	10986
1981	1377	2769	1191	1270	2680	1489	10775	1975	10986
1982	1588	2769	1191	1270	2680	1489	10986	1976	10986
1983	1535	2769	1191	1270	2550	1449	10763	1978	10986
1984	1485	2769	1191	1188	1663	1432	9727	1980	10986
1985	1588	2769	1191	1268	2680	1489	10984	1982	10986

AVG. = 10465
MIN. = 5540

* NATURAL FLOWS IN MOSQUITO CREEK ARE NOT INCLUDED

- A. A 70,000 ac-ft. confluence site with the capacity of the Little Bow Canal Increased to 300 cfs.
- B. Squaw Coulee site #2 at 14,400 ac-ft. of storage
- C. Squaw Coulee site #2, a confluence site @ 70,000 ac-ft storage and the Little Bow Canal at 300 cfs.

In all simulations the maximum diversion to the Little Bow Basin was 60% of the daily flow but the flow in the Highwood must be greater than 70 cfs. Also the Squaw Coulee diversion capacity was set at 60 cfs.

The results of the above-described simulations are displayed in Table 5.3. As expected, the total Irrigation development with, or without, the Clear Lake project remains the same when a confluence site alone is built. This means that the Irrigation acreage developed at Clear Lake must be directly subtracted from development potential elsewhere. The maximum total acreage that can be developed along Mosquito Creek with an 8000 acre Clear Lake project is 2500 acres at a Squaw Coulee Diversion capacity of 60 cfs. Along the upper Little Bow, maximum developable acreage, is dependant on the capacity of the Little Bow Canal and the acreage developed along Mosquito Creek. The table below presents maximum upper Little Bow acreage with an 8000 acre Clear Lake project;

DIVERSION CAPACITIES LITTLE BOW (cfs)	SQUAW COULEE (cfs)	CLEAR LAKE PROJECT (acres)	MOSQUITO CREEK (acres)	UPPER LITTLE BOW (acres)
100	60	8000	2500	7500
200	60	8000	2500	10500
300	60	8000	2500	11000

60%/70 cfs Guideline

TABLE 5.3
CLEAR LAKE ANALYSIS
SUMMARY OF RESULTS

RESERVOIR CAPACITY 7B-1 (ac-ft)	SQ#2	LITTLE BOW CANAL (cfs)	LOWER LITTLE BOW (acres)	IRRIGATION DEVELOPMENT UPPER L.BOW (acres)	MOSQUITO CREEK (acres)	CLEAR LAKE PROJECT (acres)	TOTAL LAKE DEVELOPMENT (acres)
70000	-	300	41500	3000	2500	8000	55000
70000	-	300	42000	3000	2000	8000	55000
-	14400	100	14000	3000	9800	-	26800
-	14400	100	13000	3000	2000	8000	26000
70000	14400	300	49000	3000	2000	-	54000
70000	14400	300	43000	3000	2000	8000	56000

When combined with a Squaw Coulee reservoir, however, the Clear Lake project will increase total basin potential for irrigation but a portion of the Clear Lake acreage must be achieved by the reduction of development elsewhere.

Finally, a combined Squaw Coulee and confluence site scheme will also increase total basin irrigation potential when the 10,000 acre Clear Lake project is included but the increase is 4,000 acres. The distribution of acreage shown in Table 5.3 is only one possible arrangement and the acreage at Clear Lake could be reduced with a subsequent improvement in irrigation potential elsewhere.

APPENDIX A
STAGE-STORAGE/AREA TABLES FOR POTENTIAL RESERVOIRS

ALTERNATIVE RESERVOIR SITES
STAGE-SURFACE AREA/STORAGE TABLE

SQUAM COULEE #2	DRAINAGE AREA	20.0	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3350.0	0.0	0.0
	3450.0	35.0	200.0
	3462.0	85.0	900.0
	3465.0	146.0	1900.0
	3475.0	250.0	3800.0
	3485.0	390.0	6600.0
	3490.0	460.0	8500.0
	3495.0	525.0	11000.0
	3500.0	605.0	14500.0
SQUAM COULEE #2A	DRAINAGE AREA	22.0	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3425.0	0.0	0.0
	3450.0	100.0	1100.0
	3466.0	245.0	4200.0
	3477.0	400.0	7600.0
	3489.0	585.0	12800.0
	3500.0	780.0	21275.0
MOSQUITO CREEK #4	DRAINAGE AREA	175.0	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3380.0	0.0	0.0
	3392.0	150.0	1000.0
	3400.0	310.0	2500.0
	3405.0	500.0	5000.0
	3414.0	850.0	10000.0
	3420.0	1100.0	17000.0
	3425.0	1300.0	22500.0
LITTLE BOW #1	DRAINAGE AREA	30.0	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3244.0	0.0	0.0
	3259.0	180.0	1000.0
	3266.0	270.0	2500.0
	3273.0	420.0	5000.0
	3280.0	600.0	8500.0
	3290.0	810.0	15500.0
LITTLE BOW #2	DRAINAGE AREA	68.0	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3210.0	0.0	0.0
	3223.0	260.0	2000.0
	3228.0	420.0	4000.0
	3235.0	720.0	8200.0
	3240.0	1000.0	13000.0
	3245.0	1350.0	20000.0
	3250.0	1780.0	28000.0
LITTLE BOW #3	DRAINAGE AREA	104.0	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3190.0	0.0	0.0
	3205.0	600.0	5000.0
	3215.0	1000.0	14000.0
	3225.0	1550.0	26000.0
	3230.0	1850.0	35000.0
	3240.0	2550.0	59000.0
	3250.0	3300.0	88000.0
LITTLE BOW #7A	DRAINAGE AREA	21.0*	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3100.0	160.0	0.0
	3117.0	760.0	9000.0
	3127.0	1150.0	17000.0
	3135.0	1500.0	27000.0
	3143.0	1900.0	40000.0
	3150.0	2200.0	55000.0
	3160.0	2660.0	80000.0
LITTLE BOW #7B1	DRAINAGE AREA	21.0*	SQUARE MILES
	ELEV	SURFACE AREA (acres)	STORAGE (ac-ft)
	3101.4	0.0	0.0
	3113.5	136.0	811.0
	3123.4	321.0	3243.0
	3133.2	680.0	8107.0
	3144.0	1013.0	17430.0
	3156.2	1618.0	34455.0
	3165.0	2113.0	50000.0
	3174.9	2718.0	72964.0

*PLUS MOSQUITO CREEK DRAINAGE AREA

APPENDIX B

MAXIMUM DIVERSION VOLUMES FOR VARIOUS CANAL CAPACITIES

B-1
 Little Bow River Basin
 Study of Diversion Canal Capacities
 Parameters: Squaw Coulee = 60 cfs, Little Bow = 100 cfs
 diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
 (acre-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE		SORTED TOTAL	YEAR
1909	4181	9805	9519	9837	9837	7858	2329	53365	*	30997	1936
1910	4184	9837	9519	9297	6087	8456	4760	52139	*	36966	1944
1911	3356	9834	9519	9837	9837	9519	4760	56661	*	37512	1931
1912	5021	9812	9519	9837	9837	9354	4220	57599	*	38821	1984
1913	5077	9820	9519	9837	9837	9492	4356	57937	*	40733	1963
1914	5047	9837	9519	9695	6134	4163	3567	47962	*	42198	1934
1915	4910	9837	9519	9837	9837	9499	4760	58198	*	42506	1922
1916	5077	9837	9519	9837	9837	9519	4760	58384	*	43015	1949
1917	5075	9837	9519	9837	9323	6944	2426	52960	*	43194	1970
1918	3659	9795	9519	9837	9765	8703	3107	54384	*	43454	1960
1919	2985	9816	9519	8725	8508	4350	1707	45610	*	43875	1938
1920	4575	9823	9519	9837	9004	4469	1435	48661	*	44390	1962
1921	4361	9556	9519	9786	7158	3408	1743	45530	*	44502	1941
1922	3784	9837	9519	9822	6656	2275	613	42506	*	44717	1967
1923	3465	9195	9519	9837	9837	7817	3081	52750	*	44743	1937
1924	3387	9837	9519	9837	9837	8505	3432	54353	*	44867	1971
1925	5077	9837	9519	9837	9153	8495	4760	56677	*	44951	1983
1926	5077	9837	9429	9789	7966	9519	4760	56376	*	44961	1957
1927	4614	9837	9519	9837	9837	9519	4760	57922	*	45530	1921
1928	5077	9837	9519	9837	9812	9091	4072	57245	*	45610	1919
1929	4722	9837	9519	9701	6016	4197	1920	45912	*	45725	1964
1930	5077	9837	9519	9837	7711	5699	2325	50004	*	45912	1929
1931	960	9763	9519	9837	4386	2627	420	37512	*	46819	1935
1932	2566	9837	9519	9837	9837	7779	2585	51959	*	47440	1961
1933	5077	9837	9519	9837	7924	8241	1366	51800	*	47442	1979
1934	5023	9837	9519	9837	3822	2669	1492	42198	*	47521	1977
1935	4357	8897	9519	9837	8127	4421	1661	46819	*	47792	1943
1936	4201	9594	9519	7009	673	0	0	30997	*	47913	1950
1937	191	9837	9519	9837	7517	4224	3619	44743	*	47962	1914
1938	4363	9837	9519	9837	5530	3231	1560	43875	*	48661	1920
1939	3498	9837	9519	9832	7844	5949	4190	50669	*	48669	1973
1940	4997	9837	9519	9177	5244	8517	4760	52051	*	48672	1966
1941	1473	8699	9519	6467	4065	9519	4760	44502	*	49751	1955
1942	5077	9837	9519	9837	9837	9519	4760	58384	*	49880	1982
1943	5077	9837	9519	9837	8250	3970	1202	47792	*	50004	1930
1944	1034	8123	9519	8358	5830	3133	968	36966	*	50669	1939
1945	1039	9506	9519	9837	9090	8638	4760	52388	*	50777	1981
1946	4808	9837	9519	9837	8632	9519	4760	56911	*	50863	1969
1947	5077	9837	9519	9837	9161	8776	4760	56965	*	51498	1956
1948	4760	9837	9519	9837	9765	6013	2414	52144	*	51672	1968
1949	5061	9696	9519	9413	4539	3134	1653	43015	*	51800	1933
1950	4822	9706	9519	9837	8990	3734	1304	47913	*	51959	1932
1951	4864	9837	9519	9837	9837	9519	4760	58171	*	52051	1940
1952	5077	9837	9519	9837	9808	7725	2637	54439	*	52139	1910
1953	3993	9837	9519	9837	9684	6638	2683	52191	*	52144	1948
1954	4189	9076	9519	9837	9837	9517	4760	56734	*	52191	1953
1955	3743	9837	9519	9837	8678	5378	2719	49751	*	52388	1945
1956	5077	9805	9519	9837	9386	5766	2107	51498	*	52693	1959
1957	5059	9837	9519	9098	5578	4213	1657	44961	*	52750	1923
1958	4827	9837	9519	9837	9752	7162	2290	53223	*	52960	1917
1959	3886	9837	9519	9837	7813	8093	3708	52693	*	53223	1958
1960	4152	9837	9519	9610	7780	2193	363	43454	*	53337	1975
1961	347	8957	9519	9801	8471	6143	4202	47440	*	53365	1909
1962	5077	9837	9519	9773	4985	4033	1166	44390	*	54353	1924
1963	1905	9674	9519	9837	6628	2776	393	40733	*	54384	1918
1964	1766	9791	9519	9837	6529	5478	2805	45725	*	54439	1952
1965	4635	9837	9519	9837	9560	9302	4760	57450	*	54440	1978
1966	3836	9699	9519	9837	9399	4571	1812	48672	*	55220	1980
1967	1473	9837	9519	9837	8579	4007	1467	44717	*	55460	1972
1968	1157	9272	9519	9837	9554	7574	4760	51672	*	56376	1926
1969	5077	9837	9519	9837	8792	5010	2793	50863	*	56510	1976
1970	3048	9699	9519	9837	5370	3941	1780	43194	*	56534	1974
1971	5077	9837	9519	9837	6114	3159	1326	44867	*	56661	1911
1972	4352	9837	9519	9837	9837	8518	3561	55460	*	56677	1925
1973	3804	9802	9519	9780	6899	6847	2018	48669	*	56734	1954
1974	5006	9837	9519	9837	9816	8828	3691	56534	*	56911	1946
1975	4892	9837	9519	9837	9825	6755	2672	53337	*	56965	1947
1976	4465	9758	9519	9818	9837	9423	3691	56510	*	57245	1926
1977	2244	9752	9415	5521	8589	8338	3663	47521	*	57450	1965
1978	4208	9837	9519	9837	9620	7967	3453	54440	*	57599	1912
1979	4579	9837	9519	9467	7665	5062	1313	47442	*	57922	1927
1980	5077	9837	9519	9372	9120	7972	4324	55220	*	57937	1913
1981	3143	9785	9519	9837	9755	6239	2498	50777	*	58171	1951
1982	4501	9676	9519	9794	6687	6270	3431	49880	*	58198	1915
1983	3775	9837	9519	9786	6489	3626	1920	44951	*	58384	1942
1984	2737	7595	9519	9360	5319	2555	1736	38821	*	58384	1916

B-2
 Little Bow River Basin
 Study of Diversion Canal Capacities
 Parameters: Squaw Coulee = 60 cfs, Little Bow = 200 cfs
 diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
 (acre-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR	
1909	4611	15623	15466	15982	14533	7886	2329	76430	*	43026	1936
1910	5604	15885	15466	12238	6087	10703	6603	72586	*	44263	1944
1911	4277	15192	15466	15107	15722	15439	7652	88856	*	49084	1931
1912	5394	14495	15466	15982	15729	10452	4220	81737	*	49982	1984
1913	7355	13623	15466	15361	15588	11397	4784	83574	*	55837	1977
1914	5961	15899	15466	14110	6134	4163	3567	65299	*	56325	1963
1915	6795	15982	15466	15982	15523	12422	7156	89325	*	56568	1949
1916	6785	15982	15466	15982	15582	15456	7733	93385	*	59138	1922
1917	6572	15684	15466	15752	11066	6991	2426	73956	*	59150	1970
1918	3659	15535	15466	15149	12759	8979	3107	74653	*	60009	1919
1919	3374	15077	15466	9817	10219	4350	1707	60009	*	60022	1960
1920	6755	15386	15466	15982	11386	4469	1435	70879	*	60166	1934
1921	4640	14566	15466	13283	7663	3408	1743	60770	*	60310	1941
1922	4187	15747	15466	14194	6656	2275	613	59138	*	60481	1957
1923	3610	13661	15466	15982	15982	7817	3081	75599	*	60770	1921
1924	3739	15979	15466	15641	15734	8851	3432	78842	*	60943	1961
1925	7469	15832	15466	14695	10429	9429	6283	79602	*	61196	1962
1926	8086	13755	12793	14219	7966	15466	7733	80018	*	61568	1937
1927	6214	15897	15466	15982	15982	15466	7733	92740	*	61999	1938
1928	6852	15982	15466	15982	13236	10372	4455	82344	*	62290	1964
1929	5859	15982	15466	13836	6016	4197	1920	63276	*	63133	1979
1930	8249	15982	15466	15901	8137	5699	2325	71758	*	63155	1983
1931	960	14411	15466	10814	4386	2627	420	49084	*	63276	1929
1932	2566	15982	15466	15982	10253	7779	2585	70613	*	63490	1935
1933	7666	15982	15466	14713	8934	9072	1366	73199	*	63662	1967
1934	5023	15982	15466	15712	3822	2669	1492	60166	*	64212	1973
1935	4878	12351	15466	15807	8906	4421	1661	63490	*	64632	1982
1936	4977	14901	15466	7009	673	0	0	43026	*	65299	1914
1937	191	15699	15466	14852	7517	4224	3619	61568	*	65743	1971
1938	4802	15936	15466	15465	5540	3231	1560	61999	*	66147	1950
1939	3730	15250	15466	14750	7998	5949	4264	67407	*	67072	1966
1940	7271	15982	15093	10435	5640	12584	7130	74137	*	67407	1939
1941	1473	10164	14251	6815	5442	14629	7536	60310	*	68706	1955
1942	7009	15722	15466	15982	15982	15466	7351	92977	*	68714	1943
1943	8128	15789	15466	15634	8425	3970	1302	68714	*	69960	1959
1944	1034	9961	14195	9143	5830	3133	968	44263	*	70613	1932
1945	1039	15130	15466	15968	11146	9518	5841	74108	*	70879	1920
1946	6444	15982	15466	15501	10110	14064	5706	83273	*	70942	1968
1947	8249	15982	15466	14951	10829	11076	7287	83840	*	71758	1930
1948	7733	15982	15466	15917	13812	6013	2414	77337	*	72425	1956
1949	6717	14137	15466	10922	4539	3134	1653	56568	*	72560	1981
1950	5808	14149	15466	15521	10164	3734	1304	66147	*	72586	1910
1951	6692	15982	15466	15982	15829	15466	7733	93150	*	73199	1933
1952	8249	15982	15466	15982	13634	7809	2637	79758	*	73543	1969
1953	5793	15982	15466	15982	12568	6638	2683	75112	*	73956	1917
1954	5087	14412	15466	15961	14183	12828	6754	84692	*	74108	1945
1955	4337	14934	15466	15982	9851	5378	2759	68706	*	74137	1940
1956	6938	14720	15466	15982	11444	5766	2109	72425	*	74653	1918
1957	6797	15982	15466	10788	5578	4213	1657	60481	*	74969	1980
1958	6214	15982	15466	15982	12300	7162	2290	75396	*	75112	1953
1959	3957	15826	15466	14945	7821	8236	3708	69960	*	75396	1958
1960	4222	15916	15466	13385	8477	2193	363	60022	*	75599	1923
1961	347	12698	15466	11985	9398	6143	4906	60943	*	75698	1978
1962	8183	14283	15466	13079	4985	4033	1166	61196	*	75817	1975
1963	1914	13172	15466	15713	6891	2776	393	56325	*	76430	1909
1964	1766	15582	15466	14594	6600	5478	2805	62290	*	77337	1948
1965	6868	15750	15466	15982	11928	11366	7376	84737	*	78248	1974
1966	3836	15207	15466	15469	10712	4571	1812	67072	*	78463	1972
1967	1473	15982	15466	15817	9451	4007	1467	63662	*	78842	1924
1968	1157	12497	15466	15333	11293	8843	6353	70942	*	79602	1925
1969	8249	15982	15466	15982	10063	5010	2793	73543	*	79758	1952
1970	3048	15407	15466	14139	5370	3941	1780	59150	*	79856	1976
1971	8249	15982	15466	15305	6258	3159	1326	65743	*	80016	1926
1972	5108	15982	15466	15982	13745	8620	3561	78463	*	81737	1912
1973	3939	14927	15466	14028	6940	6894	2018	64212	*	82344	1928
1974	6067	15982	15466	15709	12040	9293	3691	78248	*	83273	1946
1975	6736	15494	15466	15971	12723	6755	2672	75817	*	83574	1913
1976	4594	15445	15466	13977	15508	11177	3691	79856	*	83840	1947
1977	2244	13230	13027	5521	9779	8374	3663	55837	*	84692	1954
1978	5043	15982	15466	15982	11413	8360	3453	75698	*	84737	1965
1979	5396	15982	15466	11989	7925	5062	1313	63133	*	88856	1911
1980	8195	15982	15466	11636	10903	8402	4385	74969	*	89325	1915
1981	3198	15556	15466	15982	13621	6239	2498	72560	*	92740	1927
1982	5126	13434	15466	14217	6687	6270	3431	64632	*	92977	1942
1983	5162	15982	15466	14510	6489	3626	1920	63155	*	93150	1951
1984	2737	10032	15466	12137	5319	2555	1736	49982	*	93385	1916

B-3
Little Bow River Basin
Study of Diversion Canal Capacities
Parameters: Squaw Coulee = 60 cfs, Little Bow = 300 cfs
diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
(acre-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR	
1909	4611	20392	21434	22148	17218	7886	2329	96019	*	44821	1944
1910	6531	21094	21434	13321	6087	11014	6632	86114	*	52957	1936
1911	4277	18909	21434	18456	20633	20972	8569	113250	*	56427	1931
1912	5394	18839	20850	22148	19009	10452	4220	100911	*	57000	1977
1913	8457	16880	21434	18967	19226	11397	4784	101146	*	57787	1984
1914	5961	21421	21434	17385	6134	4163	3567	80065	*	65511	1941
1915	6918	22148	21434	22148	20300	12529	7226	112703	*	66659	1949
1916	7318	22148	21434	22148	21806	19586	8753	123194	*	67536	1937
1917	6576	20910	21434	20483	11095	6991	2426	89916	*	69002	1963
1918	3659	18963	21434	17322	13608	8979	3107	87072	*	69830	1919
1919	3374	18314	20871	9917	11299	4350	1707	69830	*	70781	1961
1920	8836	20461	21434	22148	12104	4469	1435	90887	*	72300	1934
1921	4640	18953	21434	15362	7729	3408	1743	73269	*	72383	1970
1922	4264	20296	21434	16896	6656	2275	613	72434	*	72434	1922
1923	3610	16122	21434	22148	16155	7817	3081	90368	*	72974	1957
1924	3739	21239	21434	19068	19860	8851	3432	97623	*	73269	1921
1925	8395	21029	21434	17339	10680	9429	6322	94627	*	73780	1960
1926	9819	14397	15313	17109	7966	21434	10717	96755	*	73829	1962
1927	7208	20831	21434	22148	22148	21418	10717	125905	*	74998	1979
1928	8315	21952	21434	21905	14206	10372	4455	102638	*	75677	1973
1929	6319	21584	21434	16173	6016	4197	1920	77642	*	75955	1935
1930	10989	22148	21434	20702	8137	5699	2325	91434	*	76450	1982
1931	960	15786	21434	10814	4386	2627	420	56427	*	76543	1983
1932	2566	22148	21434	20351	10253	7779	2585	87117	*	77329	1964
1933	7666	22148	21434	17871	9025	9270	1366	88780	*	77401	1938
1934	5023	22148	21434	15712	3822	2669	1492	72300	*	77642	1929
1935	4878	15482	21434	19173	8906	4421	1661	75955	*	79716	1971
1936	5065	18776	21434	7009	673	0	0	52957	*	79792	1939
1937	191	15699	21434	14852	7517	4224	3619	67536	*	80065	1914
1938	5002	21242	21434	19392	5540	3231	1560	77401	*	80199	1967
1939	3730	18588	21097	18165	7998	5949	4264	79792	*	80417	1950
1940	8348	21930	20079	10896	5640	14893	7997	89783	*	81713	1966
1941	1473	10419	17403	6815	6554	14886	7961	65511	*	82236	1968
1942	7256	20809	21434	22148	22148	21434	7351	122581	*	83505	1955
1943	10368	19479	21434	20402	8425	3970	1302	85380	*	83804	1959
1944	1034	10054	14660	9143	5830	3133	968	44821	*	85380	1943
1945	1039	19736	21434	20954	11239	9518	5841	89761	*	86114	1910
1946	7392	22054	21434	19764	11149	16152	5706	103651	*	87072	1918
1947	11067	22148	21434	18365	11616	12903	7469	105002	*	87117	1932
1948	10717	22148	21434	20683	15952	6013	2414	99360	*	88780	1933
1949	6799	18267	21322	10946	4539	3134	1653	66659	*	88791	1956
1950	6030	18326	21434	19423	10164	3734	1304	80417	*	89442	1980
1951	7507	22148	21434	22148	20044	21434	10717	125433	*	89761	1945
1952	11431	21754	21434	21568	14601	7809	2637	101235	*	89783	1940
1953	7583	22148	21434	21449	12775	6638	2683	94711	*	89916	1917
1954	5708	19359	21434	20989	15603	13138	7401	103632	*	90368	1923
1955	4400	18022	21434	21661	9851	5378	2759	83505	*	90819	1981
1956	6989	19292	21434	21641	11559	5766	2109	88791	*	90887	1920
1957	7046	22148	21339	10993	5578	4213	1657	72974	*	91434	1930
1958	6888	22148	21434	22148	13096	7162	2290	95167	*	93047	1975
1959	3957	20574	21434	18073	7821	8236	3708	83804	*	93476	1978
1960	4222	21614	21434	15467	8486	2193	363	73780	*	94579	1969
1961	347	15983	21173	12631	9551	6143	4953	70781	*	94627	1925
1962	10600	17891	21434	13720	4985	4033	1166	73829	*	94711	1953
1963	1914	15282	21434	20313	6891	2776	393	69002	*	95167	1958
1964	1766	21351	21434	17895	6600	5478	2805	77329	*	95884	1974
1965	8670	19270	21434	20851	12645	11433	7435	101739	*	96019	1909
1966	3836	20332	21434	19016	10712	4571	1812	81713	*	96464	1972
1967	1473	22148	21434	20220	9451	4007	1467	80199	*	96623	1976
1968	1157	14790	21434	18129	11411	8954	6362	82236	*	96755	1926
1969	11431	22148	21434	21683	10079	5010	2793	94579	*	97623	1924
1970	3048	20391	21434	16419	5370	3941	1780	72383	*	99360	1948
1971	8338	21937	21434	17265	6258	3159	1326	79716	*	100911	1912
1972	5570	20856	21434	21819	14605	8620	3561	96464	*	101146	1913
1973	3939	18453	21434	15999	6940	6894	2018	75677	*	101235	1952
1974	6862	22148	21434	20174	12281	9293	3691	95884	*	101739	1965
1975	7351	20438	21434	21151	13247	6755	2672	93047	*	102638	1928
1976	4594	20930	21259	15707	19266	11177	3691	96623	*	103632	1954
1977	2244	13742	13566	5521	9891	8374	3663	57000	*	103651	1946
1978	5570	21946	21434	21266	11440	8367	3453	93476	*	105002	1947
1979	5847	20857	21285	12709	7925	5062	1313	74998	*	112703	1915
1980	10147	21934	21424	12049	11101	8402	4385	89442	*	113250	1911
1981	3198	20389	21434	22148	14912	6239	2498	90819	*	122581	1942
1982	5126	16431	21434	17069	6687	6270	3431	76450	*	123194	1916
1983	6156	20358	21253	16742	6489	3626	1920	76543	*	125433	1951
1984	2737	11068	21421	12949	5319	2555	1736	57787	*	125905	1927

B-4
Little Bow River Basin
Study of Diversion Canal Capacities
Parameters: Squaw Coulee = 60 cfs, Little Bow = 400 cfs
diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
(ac-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR
1909	4611	24410	27381	27944	18714	7886	2329	113274	*	44821 1944
1910	6951	25201	26804	13741	6087	11014	6632	96432	*	57000 1977
1911	4277	21420	27381	20586	23562	25111	8569	130907	*	59255 1936
1912	5394	22469	24118	28294	20732	10452	4220	115678	*	62509 1931
1913	8789	19047	27342	21942	19495	11397	4784	112797	*	63752 1984
1914	5961	26025	27355	19374	6134	4163	3567	92579	*	67866 1941
1915	6918	28294	27381	28294	23964	12529	7226	134604	*	73483 1937
1916	7576	27678	27381	28146	25720	21966	8753	147220	*	73799 1949
1917	6576	25866	27381	24349	11095	6991	2426	104685	*	76007 1919
1918	3659	20135	26951	17384	13723	8979	3107	93938	*	78737 1961
1919	3374	20956	23641	9917	12063	4350	1707	76007	*	80621 1963
1920	10381	25417	27381	27739	12108	4469	1435	108929	*	81808 1922
1921	4640	22324	27252	16356	7729	3408	1743	83452	*	83022 1979
1922	4264	23711	26779	17509	6656	2275	613	81808	*	83354 1970
1923	3610	17991	27381	28294	16155	7817	3081	104329	*	83452 1921
1924	3739	24894	26820	20971	22554	8851	3432	111261	*	83481 1962
1925	8395	24748	27381	18138	10680	9429	6322	105092	*	84059 1983
1926	10208	14428	17692	19493	7966	27219	13373	110379	*	84114 1957
1927	7390	24332	27381	28294	27801	26708	13690	155595	*	84392 1934
1928	9540	27121	27381	26208	14206	10372	4455	119283	*	85546 1960
1929	6400	26334	27342	16590	6016	4197	1920	88799	*	85695 1973
1930	12490	28294	27381	23895	8137	5699	2325	108220	*	85752 1935
1931	960	15943	27360	10814	4386	2627	420	62509	*	86502 1982
1932	2566	28294	27381	20351	10253	7779	2585	99209	*	87829 1939
1933	7666	28294	27381	19938	9025	9270	1366	102940	*	88799 1929
1934	5023	28294	27381	15712	3822	2669	1492	84392	*	90587 1938
1935	4878	18257	27381	20248	8906	4421	1661	85752	*	90794 1964
1936	5065	19126	27381	7009	673	0	0	59255	*	91520 1971
1937	191	15699	27381	14852	7517	4224	3619	73483	*	92029 1968
1938	5002	25382	27381	22492	5540	3231	1560	90587	*	92579 1914
1939	3730	19441	25719	20728	7998	5949	4264	87829	*	93152 1950
1940	9048	27560	24207	11018	5640	16119	8097	101690	*	93938 1918
1941	1473	10419	19494	6815	6818	14886	7961	67866	*	94467 1966
1942	7256	25651	27381	28294	28294	27381	7351	151607	*	95049 1959
1943	11726	21994	27381	24061	8425	3970	1302	98860	*	95649 1967
1944	1034	10054	14660	9143	5830	3133	968	44821	*	96432 1910
1945	1039	23271	27381	25363	11239	9518	5841	103652	*	97155 1955
1946	7796	26833	27381	23000	11804	16172	5706	118691	*	98860 1943
1947	13462	28294	27381	20589	11963	13984	7469	123141	*	99209 1932
1948	13110	28294	27381	23228	16700	6013	2414	117140	*	99564 1980
1949	6799	21896	24833	10946	4539	3134	1653	73799	*	101690 1940
1950	6030	22489	27381	22049	10164	3734	1304	93152	*	102934 1956
1951	7990	28294	27381	28294	21959	27308	13690	154916	*	102940 1933
1952	14603	26227	27304	26090	14795	7809	2637	119464	*	103652 1945
1953	9186	28184	27381	25769	12775	6638	2683	112616	*	104329 1923
1954	6303	23553	27381	25289	16389	13138	7409	119462	*	104685 1917
1955	4400	20797	27381	26589	9851	5378	2759	97155	*	104998 1981
1956	6989	23295	27209	26006	11559	5766	2109	102934	*	105092 1925
1957	7071	28294	26309	10993	5578	4213	1657	84114	*	107914 1976
1958	7303	28294	26958	28190	13202	7162	2290	113399	*	108151 1975
1959	3957	24275	27381	19671	7821	8236	3708	95049	*	108220 1930
1960	4222	26459	27381	16442	8486	2193	363	85546	*	108383 1978
1961	347	18835	26017	12889	9551	6143	4953	78737	*	108929 1920
1962	11681	20761	27099	13756	4985	4033	1166	83481	*	109817 1972
1963	1914	17006	27381	24261	6891	2776	393	80621	*	110379 1926
1964	1766	26502	27381	20263	6600	5478	2805	90794	*	111261 1924
1965	9355	20008	27381	24512	12823	11433	7435	112947	*	111746 1974
1966	3836	25257	27132	21147	10712	4571	1812	94467	*	112616 1953
1967	1473	28176	27381	23695	9451	4007	1467	95649	*	112797 1913
1968	1157	16780	27381	19985	11411	8954	6362	92029	*	112947 1965
1969	13738	28294	27381	26321	10079	5010	2793	113615	*	113274 1909
1970	3048	24158	27381	17676	5370	3941	1780	83354	*	113399 1958
1971	8338	27431	27359	17649	6258	3159	1326	91520	*	113615 1969
1972	5768	24622	27381	25260	14605	8620	3561	109817	*	115678 1912
1973	3939	21655	27381	18688	6940	6894	2018	85695	*	117140 1948
1974	7655	28294	27381	23150	12281	9293	3691	111746	*	118691 1946
1975	7561	25195	27381	25309	13278	6755	2672	108151	*	119283 1928
1976	4594	26182	24116	16129	22026	11177	3691	107914	*	119462 1954
1977	2244	13742	13566	5521	9891	8374	3663	57000	*	119464 1952
1978	5965	26351	27381	25427	11440	8367	3453	108383	*	123141 1947
1979	5873	24463	25677	12709	7925	5062	1313	83022	*	130907 1911
1980	10756	25929	26942	12049	11101	8402	4385	99564	*	134604 1915
1981	3198	24007	27381	26762	14912	6239	2498	104998	*	147220 1916
1982	5126	18690	27381	18916	6687	6270	3431	86502	*	151607 1942
1983	6750	22534	25439	17301	6489	3626	1920	84059	*	154916 1951
1984	2737	11523	26705	13176	5319	2555	1736	63752	*	155595 1927

B-5
Little Bow River Basin
Study of Diversion Canal Capacities
Parameters: Squaw Coulee = 60 cfs, Little Bow = 500 cfs
diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversions
(ac-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR	
1909	4611	27616	33328	32599	19603	7886	2329	127972	*	44821	1944
1910	6951	27772	30969	13741	6087	11014	6632	103167	*	57000	1977
1911	4277	23002	33328	21542	25436	27770	8569	143924	*	62509	1931
1912	5394	25045	27098	34425	21840	10452	4220	128473	*	62528	1936
1913	8789	20923	32874	23418	19495	11397	4784	121680	*	68596	1984
1914	5961	29411	32795	20302	6134	4163	3567	102333	*	69414	1941
1915	6918	34399	33328	34439	25915	12529	7226	154753	*	77921	1949
1916	7576	31216	33328	33464	28473	23142	8753	165951	*	79430	1937
1917	6576	30779	33328	27160	11095	6991	2426	118355	*	79645	1919
1918	3659	20281	30619	17384	13723	8979	3107	97751	*	85343	1961
1919	3374	23335	24305	9917	12657	4350	1707	79645	*	89014	1983
1920	11245	30151	33223	32571	12108	4469	1435	125202	*	89067	1979
1921	4540	25093	32467	16369	7729	3408	1743	91449	*	89102	1922
1922	4264	26665	31076	17554	6656	2275	613	89102	*	91004	1962
1923	3610	18893	33328	34439	16155	7817	3081	117323	*	91449	1921
1924	3739	26576	31578	22366	23990	8851	3432	120532	*	91613	1963
1925	8395	28303	33008	18240	10680	9429	6322	114376	*	92668	1970
1926	10208	14428	20071	21109	7966	31651	13933	119366	*	93123	1935
1927	7390	27504	33328	33468	31511	31206	16664	181070	*	93677	1939
1928	10330	32029	32549	29711	14206	10372	4455	133652	*	93735	1957
1929	6400	30651	32300	16590	6016	4197	1920	98074	*	94396	1960
1930	13472	33977	33328	24660	8137	5699	2325	121598	*	94704	1982
1931	960	15943	27360	10814	4386	2627	420	62509	*	95009	1973
1932	2566	34439	33328	20351	10253	7779	2585	111301	*	96484	1934
1933	7666	34439	33328	20883	9025	9270	1366	115976	*	97751	1918
1934	5023	34439	33328	15712	3822	2669	1492	96484	*	98074	1929
1935	4878	20295	32692	20269	8906	4421	1661	93123	*	99939	1968
1936	5065	19143	30638	7009	673	0	0	62528	*	101188	1964
1937	191	15699	33328	14852	7517	4224	3619	79430	*	101689	1971
1938	5002	28802	33328	24704	5540	3231	1560	102166	*	102166	1938
1939	3730	19443	29704	22588	7998	5949	4264	93677	*	102333	1914
1940	9463	32054	27516	11018	5640	16846	8097	110636	*	103167	1910
1941	1473	10419	21042	6815	6818	14886	7961	69414	*	104246	1966
1942	7256	30296	33328	34439	32050	29251	7351	173970	*	105061	1950
1943	12081	24250	33328	26723	8425	3970	1302	110078	*	105201	1959
1944	1034	10054	14660	9143	5830	3133	968	44821	*	107364	1980
1945	1039	26384	33328	29344	11239	9518	5841	116693	*	109834	1967
1946	7796	29854	33328	25618	12178	16172	5706	130651	*	109963	1955
1947	15038	34439	33328	21823	11999	14345	7469	138440	*	110078	1943
1948	15000	34439	33328	24865	16720	6013	2414	132779	*	110636	1940
1949	6799	24272	26578	10946	4539	3134	1653	77921	*	111301	1932
1950	6030	26652	33328	23848	10164	3734	1304	105061	*	114376	1925
1951	8265	34439	33328	34253	22770	31587	16664	181305	*	115417	1976
1952	17245	29870	32447	28943	14795	7809	2637	133746	*	115431	1956
1953	10310	33877	33328	29235	12775	6638	2683	128846	*	115976	1933
1954	6795	27625	33328	28934	16673	13138	7409	133902	*	116312	1981
1955	4400	23572	33303	30700	9851	5378	2759	109963	*	116693	1945
1956	6989	26863	32346	29799	11559	5766	2109	115431	*	117323	1923
1957	7071	34439	29785	10993	5578	4213	1657	93735	*	118355	1917
1958	7699	33776	30707	31847	13202	7162	2290	126683	*	119366	1926
1959	3957	27485	33328	20666	7821	8236	3708	105201	*	120207	1972
1960	4222	29297	33067	16767	8486	2193	363	94396	*	120296	1978
1961	347	21214	30245	12889	9551	6143	4953	85343	*	120532	1924
1962	12011	23403	31649	13756	4985	4033	1166	91004	*	121598	1930
1963	1914	18540	33328	27772	6891	2776	393	91613	*	121680	1913
1964	1766	29501	33328	21710	6600	5478	2805	101188	*	121687	1975
1965	9451	20518	33254	27541	12823	11433	7435	122456	*	122456	1965
1966	3836	29186	31898	22232	10712	4571	1812	104246	*	125202	1920
1967	1473	34123	33328	25987	9451	4007	1467	109834	*	126540	1974
1968	1157	18580	32820	20657	11411	8954	6362	99939	*	126683	1958
1969	13738	34228	32587	30286	10079	5010	2793	128721	*	127972	1909
1970	3048	27241	33044	18245	5370	3941	1780	92668	*	128473	1912
1971	6338	32080	32880	17649	6258	3159	1326	101689	*	128721	1969
1972	5766	28213	33328	26113	14605	8620	3561	120207	*	128846	1953
1973	3939	24739	33328	17151	6940	6894	2018	95009	*	130651	1946
1974	8448	34409	33328	25089	12281	9293	3691	126540	*	132779	1948
1975	7615	29196	33328	28843	13278	6755	2672	121687	*	133652	1928
1976	4594	31185	24313	16133	24324	11177	3691	115417	*	133746	1952
1977	2244	13742	13566	5521	9891	8374	3663	57000	*	133902	1954
1978	6105	29575	33328	28029	11440	8367	3453	120296	*	138440	1947
1979	5873	27656	28529	12709	7925	5062	1313	89067	*	143924	1911
1980	10931	28783	31713	12049	11101	8402	4385	107364	*	154753	1915
1981	3198	27377	33328	28760	14912	6239	2498	116312	*	165951	1916
1982	5126	19871	33310	20009	6687	6270	3431	94704	*	173970	1942
1983	7077	24464	28137	17301	6489	3626	1920	89014	*	181070	1927
1984	2737	11721	31351	13176	5319	2555	1736	68596	*	181305	1951

Little Bow River Basin
Study of Diversion Canal Capacities

Parameters: Squaw Coulee = 120 cfs, Little Bow = 100 cfs
diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversions
(ac-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR
1909	4602	13377	13092	13528	13034	7886	2329	67848	*	1936
1910	5208	13528	13092	11464	6087	10088	6169	65635	*	1944
1911	4139	13246	13092	13217	13426	13092	6546	76757	*	1931
1912	5394	12674	13092	13528	13528	10441	4220	72876	*	1984
1913	5640	12189	13092	13496	13503	11161	4716	74796	*	1963
1914	5961	13524	13092	12532	6134	4163	3567	58973	*	1949
1915	6349	13528	13092	13528	13447	11767	6514	78225	*	1922
1916	6405	13528	13092	13528	13528	13092	6546	79721	*	1934
1917	6289	13416	13092	13528	10793	6991	2426	66534	*	1970
1918	3659	13367	13092	13419	11938	8979	3107	67560	*	1977
1919	3239	13118	13092	9628	9614	4350	1707	54747	*	1960
1920	5884	13237	13092	13528	10665	4469	1435	62310	*	1919
1921	4640	12677	13092	12131	7550	3408	1743	55241	*	1957
1922	4029	13528	13092	12743	6656	2275	613	52935	*	1938
1923	3610	11944	13092	13528	13528	7817	3081	66599	*	1962
1924	3719	13528	13092	13499	13513	8851	3432	69634	*	1921
1925	6688	13513	13092	13252	10165	9378	6082	72168	*	1941
1926	6977	12858	11501	12710	7966	13092	6546	71650	*	1937
1927	5612	13522	13092	13528	13528	13092	6546	78920	*	1964
1928	6218	13528	13092	13528	12346	10356	4455	73522	*	1983
1929	5464	13528	13092	12441	6016	4197	1920	56657	*	1961
1930	6982	13528	13092	13528	8137	5699	2325	63290	*	1967
1931	960	12715	13092	10814	4386	2627	420	45014	*	1929
1932	2566	13528	13092	13528	10253	7779	2585	63331	*	1979
1933	6982	13528	13092	13065	8690	8835	1366	65558	*	1935
1934	5023	13528	13092	13528	3822	2669	1492	53153	*	1971
1935	4805	11007	13092	13524	8847	4421	1661	57357	*	1973
1936	4780	12835	13092	7009	673	0	0	38389	*	1914
1937	191	13528	13092	13528	7517	4224	3619	55698	*	1982
1938	4643	13528	13092	13378	5540	3231	1560	54971	*	1950
1939	3672	13344	13092	12970	7998	5949	4264	61289	*	1966
1940	6610	13528	12965	10119	5575	11122	6410	66328	*	1943
1941	1473	9890	12686	6815	4899	13002	6546	55311	*	1939
1942	5686	13457	13092	13528	13528	13092	6546	79928	*	1955
1943	6975	13447	13092	13463	8425	3970	1302	60674	*	1920
1944	1034	9582	12902	9098	5830	3133	968	42546	*	1930
1945	1039	12914	13092	13528	10825	9504	5800	66700	*	1932
1946	6012	13528	13092	13414	9635	12613	5706	74001	*	1959
1947	6982	13528	13092	13157	10410	10285	6468	73922	*	1981
1948	6546	13528	13092	13528	12489	6013	2414	67609	*	1968
1949	6348	12410	13092	10768	4539	3134	1653	51944	*	1969
1950	5571	12414	13092	13473	10100	3734	1304	59687	*	1956
1951	6069	13528	13092	13528	13528	13092	6546	79382	*	1933
1952	6982	13528	13092	13528	12578	7809	2637	70154	*	1910
1953	5080	13528	13092	13528	11755	6638	2683	66305	*	1953
1954	4770	12291	13092	13528	13080	12199	6241	75201	*	1940
1955	4111	13223	13092	13528	9617	5378	2759	61707	*	1917
1956	6468	12900	13092	13528	10986	5766	2109	64848	*	1923
1957	6432	13528	13092	10391	5578	4213	1657	54890	*	1945
1958	5807	13528	13092	13528	11584	7162	2290	66991	*	1958
1959	3957	13528	13092	13149	7821	8236	3708	63491	*	1918
1960	4222	13528	13092	12123	8317	2193	363	53838	*	1948
1961	347	11304	13092	11597	9220	6143	4800	56503	*	1975
1962	6982	12780	13092	12088	4985	4033	1166	55125	*	1978
1963	1914	12022	13092	13485	6891	2776	393	50573	*	1909
1964	1766	13287	13092	12977	6600	5478	2805	56004	*	1980
1965	5998	13528	13092	13528	11317	10785	6546	74793	*	1924
1966	3836	13060	13092	13424	10565	4571	1812	60359	*	1972
1967	1473	13528	13092	13528	9443	4007	1467	56536	*	1952
1968	1157	11367	13092	13431	10954	8459	6081	64541	*	1974
1969	6982	13528	13092	13528	9851	5010	2793	64783	*	1926
1970	3048	13152	13092	12856	5370	3941	1780	53239	*	1976
1971	6982	13528	13092	13405	6258	3159	1326	57749	*	1925
1972	4871	13528	13092	13528	12746	8620	3561	69945	*	1912
1973	3939	13068	13092	12678	6940	6894	2018	58629	*	1928
1974	5721	13528	13092	13528	11751	9293	3691	70601	*	1947
1975	6185	13298	13092	13528	12181	6755	2672	67711	*	1946
1976	4594	13211	13092	12636	13461	11149	3691	71833	*	1965
1977	2244	12267	12040	5521	9538	8374	3663	53646	*	1913
1978	4733	13528	13092	13528	11133	8281	3453	67748	*	1954
1979	5104	13528	13092	11184	7925	5062	1313	57207	*	1911
1980	6982	13528	13092	11116	10473	8402	4385	67977	*	1915
1981	3198	13354	13092	13528	12382	6239	2498	64291	*	1927
1982	5019	12158	13092	12717	6687	6270	3431	59376	*	1951
1983	4608	13528	13092	12865	6489	3626	1920	56128	*	1916
1984	2737	9355	13092	11455	5319	2555	1736	46250	*	1942

Little Bow River Basin

Study of Diversion Canal Capacities

Parameters: Squaw Coulee = 120 cfs, Little Bow = 200 cfs.
 diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
 (acre-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR
1909	4611	18542	19038	19673	16331	7886	2329	88412	*	44821 1944
1910	6199	19085	19038	12989	6087	11014	6632	81045	*	49185 1936
1911	4277	17484	19038	17417	18885	18774	8405	104281	*	53881 1931
1912	5394	17217	18975	19673	17908	10452	4220	93838	*	54950 1984
1913	8060	15691	19038	17609	18029	11397	4784	94608	*	56904 1977
1914	5961	19391	19038	16149	6134	4163	3567	74404	*	62747 1949
1915	6918	19673	19038	19673	18455	12529	7226	103512	*	63976 1941
1916	7142	19673	19038	19673	19600	18138	8679	111944	*	64080 1963
1917	6576	18837	19038	18685	11095	6991	2426	83649	*	65141 1937
1918	3659	17999	19038	16855	13446	8979	3107	83083	*	66399 1919
1919	3374	17159	18962	9917	10931	4350	1707	66399	*	67070 1961
1920	8037	18465	19038	19673	11998	4469	1435	83116	*	67361 1970
1921	4640	17305	19038	14664	7729	3408	1743	68527	*	67429 1934
1922	4264	18719	19038	16172	6656	2275	613	67737	*	67737 1922
1923	3610	15313	19038	19673	16155	7817	3081	84689	*	68117 1957
1924	3737	19252	19038	17959	18355	8851	3432	90627	*	68453 1960
1925	8228	19182	19038	16410	10662	9429	6322	89271	*	68527 1921
1926	9274	14293	14355	16071	7966	19038	9519	90516	*	69011 1962
1927	6999	19009	19038	19673	19673	19038	9519	112950	*	70818 1979
1928	7756	19649	19038	19673	14004	10372	4455	94947	*	71289 1973
1929	6159	19483	19038	15432	6016	4197	1920	72245	*	71392 1964
1930	10026	19673	19038	18940	8137	5699	2325	83839	*	71432 1938
1931	960	15636	19038	10814	4386	2627	420	53881	*	71465 1935
1932	2566	19673	19038	19673	10253	7779	2585	81568	*	71899 1982
1933	7666	19673	19038	16759	9025	9265	1366	82792	*	72046 1983
1934	5023	19673	19038	15712	3822	2669	1492	67429	*	72245 1929
1935	4878	14256	19038	18305	8906	4421	1661	71465	*	73709 1967
1936	5065	17399	19038	7009	673	0	0	49185	*	74404 1914
1937	191	15699	19038	14852	7517	4224	3619	65141	*	74558 1971
1938	5002	19178	19038	17884	5540	3231	1560	71432	*	74940 1950
1939	3730	17550	18948	16958	7998	5949	4264	75398	*	75398 1939
1940	7946	19615	18082	10816	5640	14084	7718	83905	*	76068 1966
1941	1473	10419	16267	6815	6155	14886	7961	63976	*	77807 1955
1942	7205	18813	19038	19673	19673	19038	7351	110791	*	77971 1968
1943	9565	18275	19038	18589	8425	3970	1302	79165	*	78519 1959
1944	1034	10054	14660	9143	5830	3133	968	44821	*	79165 1943
1945	1039	18193	19038	19051	11239	9518	5841	83920	*	81045 1910
1946	7040	19673	19038	18231	10760	15505	5706	95954	*	81568 1932
1947	10011	19673	19038	17243	11339	12257	7469	97030	*	82506 1956
1948	9519	19673	19038	19001	15322	6013	2414	90981	*	82792 1933
1949	6799	16638	19038	10946	4539	3134	1653	62747	*	83083 1918
1950	6030	16650	19038	18019	10164	3734	1304	74940	*	83116 1920
1951	7267	19673	19038	19673	18603	19038	9519	112813	*	83649 1917
1952	10154	19631	19038	19463	14325	7809	2637	93058	*	83829 1981
1953	6864	19673	19038	19448	12775	6638	2683	87120	*	83839 1930
1954	5469	17486	19038	19131	15176	13096	7241	96638	*	83905 1940
1955	4400	16904	19038	19476	9851	5378	2759	77807	*	83920 1945
1956	6989	17459	19038	19585	11559	5766	2109	82506	*	84235 1980
1957	6966	19673	19038	10991	5578	4213	1657	68117	*	84689 1923
1958	6649	19673	19038	19673	12884	7162	2290	87369	*	86308 1969
1959	3957	18816	19038	16942	7821	8236	3708	78519	*	86552 1975
1960	4222	19433	19038	14717	8486	2193	363	68453	*	86645 1978
1961	347	14705	18994	12391	9535	6143	4953	67070	*	87120 1953
1962	9786	16469	19038	13534	4985	4033	1166	69011	*	87369 1958
1963	1914	14491	19038	18577	6891	2776	393	64080	*	88412 1909
1964	1766	19036	19038	16669	6600	5478	2805	71392	*	88991 1974
1965	8088	18406	19038	19120	12406	11433	7435	95927	*	89271 1925
1966	3836	18330	19038	17769	10712	4571	1812	76068	*	89933 1972
1967	1473	19673	19038	18601	9451	4007	1467	73709	*	90499 1976
1968	1157	13911	19038	17138	11411	8954	6362	77971	*	90516 1926
1969	10154	19673	19038	19561	10079	5010	2793	86308	*	90627 1924
1970	3048	18543	19038	15641	5370	3941	1780	67361	*	90981 1948
1971	8338	19621	19038	16818	6258	3159	1326	74558	*	93058 1952
1972	5411	19165	19038	19660	14479	8620	3561	89933	*	93838 1912
1973	3939	17096	19038	15364	6940	6894	2018	71289	*	94608 1913
1974	6543	19673	19038	18516	12236	9293	3691	88991	*	94947 1928
1975	7191	18521	19038	19227	13146	6755	2672	86552	*	95927 1965
1976	4594	18774	19038	15333	17892	11177	3691	90499	*	95954 1946
1977	2244	13713	13499	5521	9891	8374	3663	56904	*	96638 1954
1978	5400	19673	19038	19274	11440	8367	3453	86645	*	97030 1947
1979	5708	19133	19038	12639	7925	5062	1313	70818	*	103512 1915
1980	9618	19673	19038	12017	11101	8402	4385	84235	*	104281 1911
1981	3198	18482	19038	19673	14700	6239	2498	83829	*	110791 1942
1982	5126	15280	19038	16065	6687	6270	3431	71899	*	111944 1916
1983	5866	19005	19038	16103	6489	3626	1920	72046	*	112813 1951
1984	2737	10808	19038	12756	5319	2555	1736	54950	*	112950 1927

B-8
Little Bow River Basin
Study of Diversion Canal Capacities
Parameters: Squaw Coulee = 120 cfs, Little Bow = 300 cfs
diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
(acre-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR
1909	4611	22951	25006	25801	18241	7886	2329	106825	*	1944
1910	6918	23981	24917	13708	6087	11014	6632	93257	*	1936
1911	4277	20548	25006	19873	22624	23656	8569	124554	*	1977
1912	5394	21100	22852	25840	20134	10452	4220	109991	*	1931
1913	8716	18256	25006	20938	19495	11397	4784	108592	*	1984
1914	5961	24323	25006	18680	6134	4163	3567	87833	*	1941
1915	6918	25840	25006	25840	22812	12529	7226	126170	*	1937
1916	7556	25798	25006	25830	24390	21290	8753	138623	*	1949
1917	6576	23887	25006	22936	11095	6991	2426	98918	*	1919
1918	3659	19837	24961	17384	13723	8979	3107	91650	*	1961
1919	3374	19952	22754	9917	1775	4350	1707	73828	*	1963
1920	9902	23438	25006	25664	12108	4469	1435	102023	*	1922
1921	4640	21159	24991	16117	7729	3408	1743	79788	*	1970
1922	4264	22452	24801	17422	6656	2275	613	78483	*	1934
1923	3610	17312	25006	25840	16155	7817	3081	98822	*	1921
1924	3739	23780	24903	20324	21560	8851	3432	106589	*	1957
1925	8395	23323	25006	17993	10680	9429	6322	101148	*	1962
1926	10141	14428	16742	18594	7966	24973	12450	105294	*	1979
1927	7359	23066	25006	25840	25690	24697	12503	144161	*	1960
1928	9065	25079	25006	24591	14206	10372	4455	112775	*	1983
1929	6400	24513	25006	16590	6016	4197	1920	84642	*	1973
1930	11943	25840	25006	22837	8137	5699	2325	101786	*	1935
1931	960	15905	25006	10814	4386	2627	420	60118	*	1982
1932	2566	25840	25006	20351	10253	7779	2585	94381	*	1929
1933	7666	25840	25006	19268	9025	9270	1366	97442	*	1939
1934	5023	25840	25006	15712	3822	2669	1492	79564	*	1938
1935	4878	17149	25006	20087	8906	4421	1661	82108	*	1964
1936	5065	19014	25006	7009	673	0	0	56768	*	1971
1937	191	15699	25006	14852	7517	4224	3619	71108	*	1914
1938	5002	23878	25006	21360	5540	3231	1560	85577	*	1950
1939	3730	19268	23945	19766	7998	5949	4264	84919	*	1968
1940	8811	25384	22718	11015	5640	15654	8097	97319	*	1967
1941	1473	10419	18703	6815	6818	14886	7961	67074	*	1966
1942	7256	23752	25006	25840	25840	25006	7351	140051	*	1959
1943	11367	21027	25006	22737	8425	3970	1302	93835	*	1918
1944	1034	10054	14660	9143	5830	3133	968	44821	*	1955
1945	1039	21879	25006	23627	11239	9518	5841	98150	*	1910
1946	7748	25275	25006	21753	11625	16172	5706	113286	*	1943
1947	12552	25840	25006	19854	11884	13677	7469	116283	*	1932
1948	12319	25840	25006	22315	16535	6013	2414	110443	*	1980
1949	6799	20579	23949	10946	4539	3134	1653	71598	*	1940
1950	6030	20827	25006	21139	10164	3734	1304	88205	*	1933
1951	7832	25840	25006	25840	21466	25006	12503	143493	*	1956
1952	13337	24519	25006	24429	14770	7809	2637	112507	*	1945
1953	8655	25809	25006	24114	12775	6638	2683	105681	*	1923
1954	6066	21891	25006	23613	16170	13138	7409	113294	*	1917
1955	4400	19689	25006	24734	9851	5378	2759	91817	*	1981
1956	6989	21793	24987	24345	11559	5766	2109	97549	*	1925
1957	7071	25840	24552	10993	5578	4213	1657	79903	*	1930
1958	7144	25840	24931	25840	13202	7162	2290	106409	*	1920
1959	3957	22862	25006	19125	7821	8236	3708	90717	*	1975
1960	4222	24701	25006	16187	8486	2193	363	81159	*	1978
1961	347	17815	24194	12869	9551	6143	4953	75873	*	1976
1962	11444	19653	24898	13756	4985	4033	1166	79934	*	1972
1963	1914	16353	25006	22747	6891	2776	393	76080	*	1926
1964	1766	24566	25006	19392	6600	5478	2805	85613	*	1974
1965	9151	19771	25006	23125	12798	11433	7435	108719	*	1953
1966	3836	23309	25006	20475	10712	4571	1812	89721	*	1958
1967	1473	25801	25006	22406	9451	4007	1467	89611	*	1924
1968	1157	15988	25006	19332	11411	8954	6362	88210	*	1969
1969	13337	25840	25006	24553	10079	5010	2793	106618	*	1909
1970	3048	22795	25006	17244	5370	3941	1780	79184	*	1913
1971	8338	25317	25006	17617	6258	3159	1326	87021	*	1965
1972	5722	23119	25006	24147	14605	8620	3561	104779	*	1912
1973	3939	20389	25006	16686	6940	6894	2018	81872	*	1948
1974	7339	25840	25006	22149	12281	9293	3691	105600	*	1952
1975	7481	23296	25006	23758	13278	6755	2672	102246	*	1928
1976	4594	24124	23481	15995	20998	11177	3691	104059	*	1946
1977	2244	13742	13566	5521	9891	8374	3663	57000	*	1954
1978	5808	24853	25006	23953	11440	8367	3453	102879	*	1947
1979	5873	23114	24124	12709	7925	5062	1313	80120	*	1911
1980	10553	24510	24799	12049	11101	8402	4385	95799	*	1915
1981	3198	22661	25006	25476	14912	6239	2498	99991	*	1916
1982	5126	17925	25006	18259	6687	6270	3431	82705	*	1942
1983	6513	21702	23876	17266	6489	3626	1920	81391	*	1951
1984	2737	11407	24700	13111	5319	2555	1736	61565	*	1927

B-9

Little Bow River Basin

Study of Diversion Canal Capacities

Parameters: Squaw Coulee = 120 cfs, Little Bow = 400 cfs
 diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
 (acre-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR
1909	4611	26397	30953	30779	19286	7886	2329	122242	*	44821 1944
1910	6951	26790	29465	13741	6087	11014	6632	100682	*	57000 1977
1911	4277	22525	30953	21194	24750	26807	8569	139076	*	62509 1931
1912	5394	24267	26023	31985	21444	10452	4220	123785	*	62528 1936
1913	8789	20211	30768	22928	19495	11397	4784	118373	*	66753 1984
1914	5961	28221	30707	20190	6134	4163	3567	98944	*	68870 1941
1915	6918	31985	30953	31985	25202	12529	7226	146798	*	76446 1949
1916	7576	29956	30953	31472	27507	22746	8753	158963	*	77055 1937
1917	6576	28843	30953	26117	11095	6991	2426	113002	*	78333 1919
1918	3659	20281	29323	17384	13723	8979	3107	96456	*	82731 1961
1919	3374	22385	24180	9917	12420	4350	1707	78333	*	86325 1922
1920	10933	28361	30953	30672	12108	4469	1435	118931	*	86844 1979
1921	4640	23991	30516	16369	7729	3408	1743	88396	*	87206 1983
1922	4264	25498	29466	17554	6656	2275	613	86325	*	87308 1963
1923	3610	18654	30953	31985	16155	7817	3081	112256	*	88271 1962
1924	3739	26013	29678	21831	23590	8851	3432	117135	*	88396 1921
1925	8395	26891	30881	18240	10680	9429	6322	110837	*	89198 1970
1926	10208	14428	19121	20561	7966	30160	13916	116360	*	90141 1957
1927	7390	26237	30953	31763	30366	29465	15477	171650	*	90646 1935
1928	10165	30098	30548	28435	14206	10372	4455	128279	*	91171 1960
1929	6400	29004	30521	16590	6016	4197	1920	94649	*	91377 1973
1930	13155	31948	30953	24493	8137	5699	2325	116710	*	91472 1939
1931	960	15943	27360	10814	4386	2627	420	62509	*	91654 1982
1932	2566	31985	30953	20351	10253	7779	2585	106473	*	91656 1934
1933	7666	31985	30953	20590	9025	9270	1366	110856	*	94649 1929
1934	5023	31985	30953	15712	3822	2669	1492	91656	*	96456 1918
1935	4878	19753	30758	20269	8906	4421	1661	90646	*	97127 1968
1936	5065	19143	30638	7009	673	0	0	62528	*	97449 1964
1937	191	15699	30953	14852	7517	4224	3619	77055	*	97700 1938
1938	5002	27569	30953	23845	5540	3231	1560	97700	*	97855 1971
1939	3730	19443	28197	21890	7998	5949	4264	91472	*	98944 1914
1940	9305	30313	26334	11018	5640	16608	8097	107317	*	100389 1950
1941	1473	10419	20498	6815	6818	14886	7961	68870	*	100682 1910
1942	7256	28475	30953	31985	31985	29251	7351	167256	*	100752 1966
1943	12002	23379	30953	25809	8425	3970	1302	105840	*	101206 1959
1944	1034	10054	14660	9143	5830	3133	968	44821	*	104294 1967
1945	1039	25177	30953	27857	11239	9518	5841	111624	*	104542 1980
1946	7796	28807	30953	24713	12042	16172	5706	126188	*	104922 1955
1947	14559	31985	30953	21414	11999	14265	7469	132644	*	105840 1943
1948	14288	31985	30953	24363	16720	6013	2414	126737	*	106473 1932
1949	6799	23434	25941	10946	4539	3134	1653	76446	*	107317 1940
1950	6030	24990	30953	23213	10164	3734	1304	100389	*	110610 1956
1951	8186	31985	30953	31951	22496	30162	15477	171210	*	110837 1925
1952	16295	28525	30569	28022	14795	7809	2637	128652	*	110856 1933
1953	9901	31661	30953	27964	12775	6638	2683	122575	*	111624 1945
1954	6637	26042	30953	27581	16594	13138	7409	128354	*	111886 1981
1955	4400	22464	30953	29117	9851	5378	2759	104922	*	112256 1923
1956	6989	25438	30386	28362	11559	5766	2109	110610	*	112652 1976
1957	7071	31985	28644	10993	5578	4213	1657	90141	*	113002 1917
1958	7541	31749	29418	30635	13202	7162	2290	121997	*	115880 1978
1959	3957	26234	30953	20296	7821	8236	3708	101206	*	116245 1972
1960	4222	28274	30940	16692	8486	2193	363	91171	*	116360 1926
1961	347	20264	28583	12889	9551	6143	4953	82731	*	116504 1975
1962	11932	22374	30024	13756	4985	4033	1166	88271	*	116710 1930
1963	1914	17959	30953	26423	6891	2776	393	87308	*	117135 1924
1964	1766	28575	30953	21272	6600	5478	2805	97449	*	118373 1913
1965	9451	20360	30953	26403	12823	11433	7435	118858	*	118858 1965
1966	3836	27803	30126	21893	10712	4571	1812	100752	*	118931 1920
1967	1473	31748	30953	25195	9451	4007	1467	104294	*	120774 1974
1968	1157	17867	30799	20577	11411	8954	6362	97127	*	121997 1958
1969	13738	31981	30611	28785	10079	5010	2793	122997	*	122242 1909
1970	3048	26059	30923	18078	5370	3941	1780	89198	*	122575 1953
1971	8338	30396	30729	17649	6258	3159	1326	97855	*	122997 1969
1972	5768	26788	30953	25950	14605	8620	3561	116245	*	123785 1912
1973	3939	23560	30953	17072	6940	6894	2018	91377	*	126188 1946
1974	8131	31985	30953	24439	12281	9293	3691	120774	*	126737 1948
1975	7615	27758	30953	27472	13278	6755	2672	116504	*	128279 1928
1976	4594	29273	24313	16133	23471	11177	3691	112652	*	128354 1954
1977	2244	13742	13566	5521	9891	8374	3663	57000	*	128652 1952
1978	6085	28380	30953	27203	11440	8367	3453	115880	*	132644 1947
1979	5873	26406	27557	12709	7925	5062	1313	86844	*	139076 1911
1980	10931	27794	29880	12049	11101	8402	4385	104542	*	146798 1915
1981	3198	26031	30953	28054	14912	6239	2498	111886	*	158963 1916
1982	5126	19537	30953	19648	6687	6270	3431	91654	*	167256 1942
1983	6998	23724	27148	17301	6489	3626	1920	87206	*	171210 1951
1984	2737	11642	29587	13176	5319	2555	1736	66753	*	171650 1927

B-10
Little Bow River Basin
Study of Diversion Canal Capacities
Parameters: Squaw Coulee = 120 cfs, Little Bow = 500 cfs
diversion factor for river: .60 minimum daily river flow: 70 cfs

Maximum Monthly Diverted Discharge for Both Diversion Canals
(acre-ft)

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL DISCHARGE	SORTED TOTAL	YEAR
1909	4611	29402	36900	35293	19930	7886	2329	136352	44821	1944
1910	6951	29021	32814	13741	6087	11014	6632	106262	57000	1977
1911	4277	23716	36900	21849	26327	29080	8569	150719	62509	1931
1912	5394	25755	28318	37301	22340	10452	4220	133779	62528	1936
1913	8789	21954	35534	24049	19495	11397	4784	126003	70128	1941
1914	5961	31008	35428	20302	6134	4163	3567	106562	70587	1984
1915	6918	37972	36900	38130	26843	12529	7226	166518	80048	1949
1916	7576	32621	36900	36220	29534	23623	8753	175226	81550	1919
1917	6576	33489	36900	28599	11095	6991	2426	126077	83002	1937
1918	3659	20281	32384	17384	13723	8979	3107	99516	89183	1961
1919	3374	24764	24424	9917	13015	4350	1707	81550	91458	1983
1920	11602	32609	36532	35227	12108	4469	1435	133983	91879	1979
1921	4640	26641	34613	16369	7729	3408	1743	95143	92997	1922
1922	4264	28332	33304	17554	6656	2275	613	92997	94587	1962
1923	3610	19174	36900	37001	16155	7817	3081	123739	95143	1921
1924	3739	27191	34436	23080	24467	8851	3432	125196	96137	1935
1925	8395	30327	35551	18240	10680	9429	6322	118943	96685	1939
1926	10208	14428	21500	21727	7966	33331	13933	123093	97226	1970
1927	7390	29409	36900	35672	32933	33817	18450	194572	97629	1957
1928	10330	34829	35407	31382	14206	10372	4455	140980	97681	1963
1929	6400	32936	34788	16590	6016	4197	1920	102848	97884	1960
1930	13921	35192	36900	24860	8137	5699	2325	127034	98945	1982
1931	960	15943	27360	10814	4386	2627	420	62509	99516	1918
1932	2566	38130	36900	20351	10253	7779	2585	118565	100074	1973
1933	7666	38130	36820	20947	9025	9270	1366	123225	102848	1929
1934	5023	38130	36900	15712	3822	2669	1492	103748	103188	1968
1935	4878	20771	35230	20269	8906	4421	1661	96137	103748	1934
1936	5065	19143	30638	7009	673	0	0	62528	105844	1964
1937	191	15699	36900	14852	7517	4224	3619	83002	106262	1910
1938	5002	30493	36900	25895	5540	3231	1560	108620	106562	1914
1939	3730	19443	31879	23422	7998	5949	4264	96685	107007	1971
1940	9598	34548	29000	11018	5640	17203	8097	115105	108620	1938
1941	1473	10419	21757	6815	6818	14886	7961	70128	108776	1966
1942	7256	32942	36900	38130	32050	29251	7351	183880	110909	1980
1943	12146	25559	36763	27622	8425	3970	1302	115787	111031	1959
1944	1034	10054	14660	9143	5830	3133	968	44821	111772	1950
1945	1039	28025	36900	31240	11239	9518	5841	123801	115105	1940
1946	7796	30908	36900	26643	12205	16172	5706	136330	115787	1943
1947	15601	38130	36900	22300	11999	14405	7469	146804	117294	1955
1948	15914	38021	36900	25535	16720	6013	2414	141518	118040	1967
1949	6799	25463	27514	10946	4539	3134	1653	80048	118565	1932
1950	6030	29039	36900	24600	10164	3734	1304	111772	118865	1976
1951	8384	38117	36888	37518	23127	33664	18429	196126	118943	1925
1952	16485	31782	34749	30147	14795	7809	2637	140404	122279	1956
1953	10786	37211	36900	31140	12775	6638	2683	138134	122747	1981
1954	7033	30006	36900	30472	16771	13138	7409	141731	123093	1926
1955	4400	25239	36687	32981	9851	5378	2759	117294	123225	1933
1956	6989	28991	35147	31717	11559	5766	2109	122279	123739	1923
1957	7071	37339	30779	10993	5578	4213	1657	97629	123801	1945
1958	7937	36634	32045	33473	13202	7162	2290	132744	125196	1924
1959	3957	29271	36900	21137	7821	8236	3708	111031	126003	1913
1960	4222	30323	35529	16767	8486	2193	363	97884	126077	1917
1961	347	22643	32656	12889	9551	6143	4953	89183	126085	1978
1962	12130	24894	33622	13756	4985	4033	1166	94587	126096	1972
1963	1914	19305	36780	29622	6891	2776	393	97681	127034	1930
1964	1766	30460	36900	21835	6600	5478	2805	105844	127487	1965
1965	9451	20756	36433	29155	12823	11433	7435	127487	128867	1975
1966	3836	30890	34367	22589	10712	4571	1812	108776	132744	1958
1967	1473	37695	36900	27047	9451	4007	1467	118040	133779	1912
1968	1157	19497	35126	20682	11411	8954	6362	103188	133983	1920
1969	13738	37266	35445	32415	10079	5010	2793	136745	134496	1974
1970	3048	28703	35952	18433	5370	3941	1780	97226	136330	1946
1971	8338	34246	36032	17649	6258	3159	1326	107007	136352	1909
1972	5768	30356	36900	26287	14605	8620	3561	126096	136745	1969
1973	3939	26205	36900	17178	6940	6894	2018	100074	138134	1953
1974	8924	37558	36900	25848	12281	9293	3691	134496	140404	1952
1975	7615	30826	36900	30821	13278	6755	2672	128867	140980	1928
1976	4594	33657	24313	16133	25301	11177	3691	118865	141518	1948
1977	2244	13742	13566	5521	9891	8374	3663	57000	141731	1954
1978	6105	31166	36900	28654	11440	8367	3453	126085	146804	1947
1979	5873	29335	29662	12709	7925	5062	1313	91879	150719	1911
1980	10931	29737	34304	12049	11101	8402	4385	110909	166518	1915
1981	3198	29357	36865	29678	14912	6239	2498	122747	175226	1916
1982	5126	20281	36763	20385	6687	6270	3431	98945	183880	1942
1983	7101	25525	29496	17301	6489	3626	1920	91458	194572	1927
1984	2737	11840	33223	13176	5319	2555	1736	70587	196126	1951